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SELF-PROTECTING TUBES AND THEIR INFLUENCE ON THE DEVELOPMENT OF X-RAY TECHNIC[1]

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IT is with great pleasure that I have accepted the invitation of the Radiological Society of North America, which enables me to tell at this meeting some results of recent investigations and some constructional details about X-ray tubes and apparatus in Europe.

Probably one of the most remarkable features in which the European development in X-ray technic differs from the American is the self-protecting tube, which in the last few years has found its way into radiological practice in all European countries.

The first, and I may say the best known, self-protecting tube is the Metalix tube, and I should like to begin by saying a few words about the history and the properties of this type of tube. The first Metalix tube for practical use was demonstrated in connection with a lecture given before the British Institute of Radiology by Dr. Heilbron, in London, in December, 1923. Further demonstrations followed: at the Dutch Physical Society, in Amsterdam,[2] at the Congress of Naturforscher und Aerzte, in Innsbruck,[3] and also at the first International Congress of Radiology, in London.[4]

The construction of this first type of tube, designed at the laboratories of Philips Glowlampworks, in Eindhoven, can easily be described with the aid of Figure 1-*A*. The main body, as with all Metalix tubes, is a chromium iron cylinder, to which glass is sealed directly. Immediately around this cylinder is a lead shield of sufficient thickness, destined to absorb practically all primary radiation from the target. The X-ray beam, in the case of Figure 1-*A*, comes down through the base of the cylinder, which is closed by a glass window. The filament terminals are connected with the plug contacts at the left. Between the circular filament in the center of the cylinder and the anode a metal plate is mounted, having a circular opening. This opening serves as a kind of diaphragm with regard to the electrons attracted by the anode, the lines of force passing through the opening. The right choice of the width of this diaphragm and its distance from the anode and

[1] Read before the Radiological Society of North America, at the Fourteenth Annual Meeting, at Chicago, Dec. 3–7, 1928.

[2] Bouwers, A.: Een nieuwe Röntgenbuis. Physica, 1924, IV, 173.

[3] Idem: Eine neue Röntgenröhre aus Metall. Fortschr. a. d. Geb. der Röntgenstr., Kongresshef. Innsbruck, 1924, p. 41.

[4] Idem: New Metal X-ray Tubes for Radiography and Therapeutics. Brit. Jour. Radiol., 1927, XXIII, 139.

from the cathode enables one to regulate both the size of the focal spot and the voltage necessary to obtain a given milliamperage for a sufficiently heated filament. This is a factor which controls one of the special

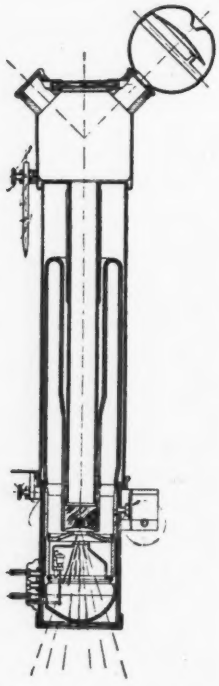

Fig. 1-*A*. Construction of first type of tube.

properties of some Metalix tubes, which will be referred to later on as "space charge effect."

The X-rays emerge from the target in a direction perpendicular to the surface. In the later type of tube (Fig. 1-*B*) the rays leave the tube through a window in its metal center part at an angle of about 20 degrees with the target surface.

The working of the diaphragm is essentially the same in both types of tubes, but in the case of the second type the diaphragm between cathode and anode is a rectangular slit, so that a long and narrow focus, a so-called "line focus," is produced.

The new way of "focussing" the electrons by means of the diaphragm makes it possible to build the Metalix tubes in such manner that the distances between the electrodes are much smaller than usual. This feature contributes to the reliability of the tubes. It also proved to be unnecessary to exhaust a Metalix tube to the same extent as a Coolidge tube, and, if suitable gases are chosen (for instance, helium), pressures even much higher than those occurring in gas tubes will do no harm and even seem to improve the life time. Figures 2-*A* and 2-*B* show the exterior of both types of tubes.

The line focus is, so far as I know, not used in the United States, although, I think, it really has some advantage over a "round focus." In fact, the intensity of radiation is substantially the same in a direction of about 20 degrees with the focal surface as it is in a 45-degree direction.[5] On the other hand, the projection of the focus, on which depends the definition of the radiographs, is smaller in case of the smaller angle.

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[5]Bouwers, A., and Diepenhorst, P.: Die Intensität der Röntgenstrahlen als Funktion des Winkels ihres Austritts aus der Antikathodenoberfläche. Fortschr. a. d. Geb. d. Röntgenstr., 1928, XXXVIII, 894.

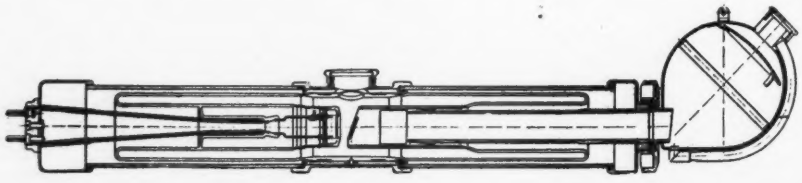

Fig. 1-*B*. "In the later type of tube the rays leave the tube through a window in its metal center part at an angle of about 20 degrees with the target surface."

Further application of this principle brings us back to the first type of Metalix tube, where the rays emerge perpendicular to the surface. In this case a conical focus has been used, as represented in Figure 3.

Figs. 2-*A* and 2-*B*. Exterior of both types of tubes.

For the definition of the roentgenograph it is the base of the cone that matters, and this base is about one-fourth the size of the actual surface of the conical shell. In addition, Figure 3 shows why, in the case of an inclined anode, this principle could not be applied.

Immediately connected with the question of the focal spot is the input a tube will stand. This input (in watts), though not universally proportional to the time of exposure, yet will be greater the shorter the time of exposure, and therefore we shall first consider the input allowed during one second. Calculation[6] and experiment have shown that the allowed input should be 200 watts for a focal spot area of one square millimeter. For one type of Metalix tube, for instance, the input is 5,000 watts during one second; therefore, the focal surface may not be larger than $\frac{5000}{200}$ mm.^{2} or 25.0 mm.^{2} This type of tube

[6]Bouwers, A.: Ueber den Temperaturverlauf an der Anode einer Röntgenröhre. Ztschr. f. techn. Physik, 1927, VIII, 271.

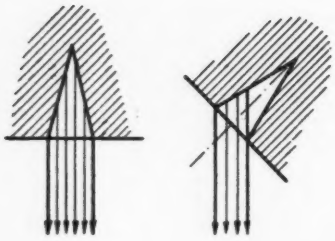

Fig. 3. Conical focus used with first type of tube.

has a line focus of 2.7 mm. width and about 8.5 mm. length.

It has been possible to calculate also[7] the inputs for shorter and longer exposure times. The result of this calculation was well in accordance with a series of experiments taken with exposures varying from 0.05 to 20 seconds. Figure 4 gives the experimental result, which holds good for all well-constructed X-ray tubes with a focal spot surface of 24 square millimeters. It can immediately be applied to focal spots of other dimensions, considering that the input is directly proportional to the size of the focus.

As the self-protecting property of the Metalix tube is its most outstanding feature it will be of interest to mention something about the way in which full protection has been obtained. This was not so simple in the case of the tube for deep therapy in which voltages of 200 K.V. and more are used. The center part of such a tube is represented in Figure 5, the general construction being similar to that shown in Figure 1-*B*.

The lead cylinder *A* surrounding the chromium iron center part of the tube is not quite sufficient because two circular openings at the ends turned towards cathode and anode are left. In the direction of the anode, however, we find a tungsten button *B* and also about half an inch of copper, which together are equivalent to at least 5 mm. of lead. In the cathode direction a tungsten plate *C* was necessary and even a smaller tungsten plate to cover the whole left of the cathode lead-in wire of the first one. In this way full protection is obtained as far as primary radiation from the focus is concerned. Another source of radiation, however, is the external surface of the anode. In fact, secondary electrons leave the focus and follow paths similar to those shown in Figure 5 and hit the anode again all over the surface, thus producing the so-called "stray radiation."[8] A certain part of this radiation, though much softer than the primary radiation, yet passes through the glass part of the tube, especially on the side turned toward the anode. It was, therefore, necessary to replace the usual

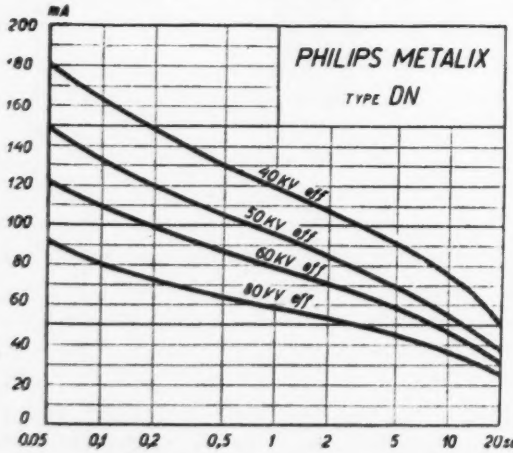

Fig. 4. "The experimental result, which holds good for all well-constructed X-ray tubes with a focal spot surface of 24 square millimeters."

[7]See footnote 6, page 193.

[8]Coolidge and Moore: Gen. Electr. Rev., 1917, XX, 272. Hausser, Bardehle, and Heisen: Fortschr. a. d. Geb. d. Röntgenstr., 1926, XXXV, 636. Bernstein and Klose: Fortschr. a. d. Geb. d. Röntgenstr., 1928, XXXVIII, 107. Lorenz: Proc. Nat. Acad. of Sc., 1928, XIV, 582.

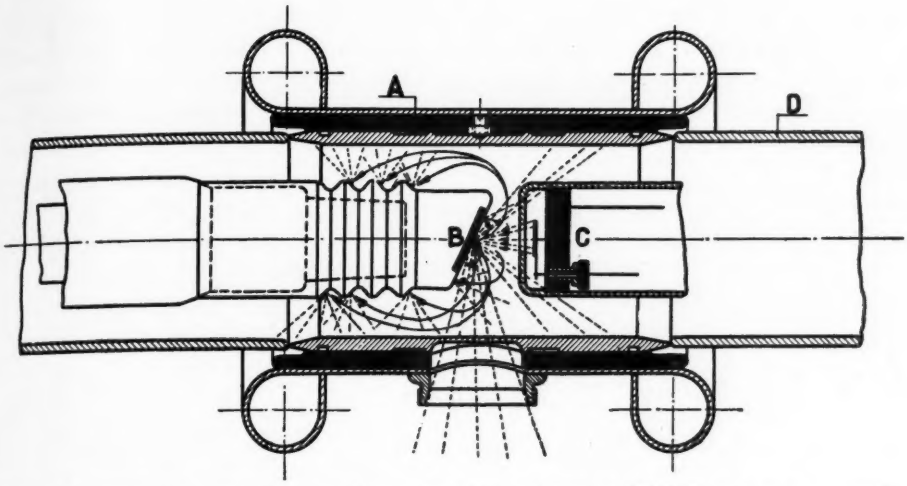

Fig. 5. The center of the tube for deep therapy in which voltages of 200 K.V. and more are used.

glass by lead glass of high absorbing capacity. Moreover, the anode was given the shape shown in Figure 5, the ribs themselves insuring a certain amount of absorption. Recently a further improvement was made, in collaboration with the C. H. F. Müller Laboratories, in Hamburg, consisting in the use of lead glass cylinders which lengthen the lead cylinder *A* on both ends by about 5 cm. The result is a protection which renders it impossible to obtain from the tube an erythema dose at a distance of 2 M. from the tube in less than 2,000 hours, provided, of course, that primary radiation is eliminated. According to Mutscheller, Glocker, Barclay and others this protection must be quite sufficient and, moreover, at least equivalent to 4 mm. of lead, which is sufficient according to the Stockholm recommendations.

About steel radiation we have made more detailed investigations, some results of which are shown in Figure 6, which I think are very instructive. Here are shown pin-hole photographs of the anodes of (*a*) a glass tube, taken without a filter, (*b*) the same tube, using a filter of 10 mm. of Al., (*c*) a Metalix tube, without a filter. In all three cases an exposure of some seconds was made to obtain the reproduction of the focal spot. Subsequently the focal spot on the film was covered with a small piece of lead, whereupon a much longer exposure with unaltered position of tube, camera, and film followed. A clear picture of the full surface of the anode was thus obtained without the disturbing effect of the so much more intense radiation of the focal spot.

By measuring the photographic density it has been possible to prove that the steel radiation is not only about 200 times weaker, but also much softer than the primary radiation, as was to be expected. Furthermore, the radiation higher up the anode was found to be stronger and more penetrating than the radiation issuing from parts farther downward. This can probably be explained by considering that only the faster electrons have a long range and that few electrons follow such paths as to come down immediately around the corner, which, so to speak, acts as a screen. Moreover, the picture shows that the steel radiation, so far as it can be observed from the direction in which the radiation emerges, is considerably less important in the case of the

Metalix tube than it is with glass tubes. This explains why in some cases Metalix tubes for diagnostics give clearer films than glass ones.

tance away from a glass tube which is in operation. Even when a glass tube is mounted with special care, a puncture, caused by some near-by metal part, is one

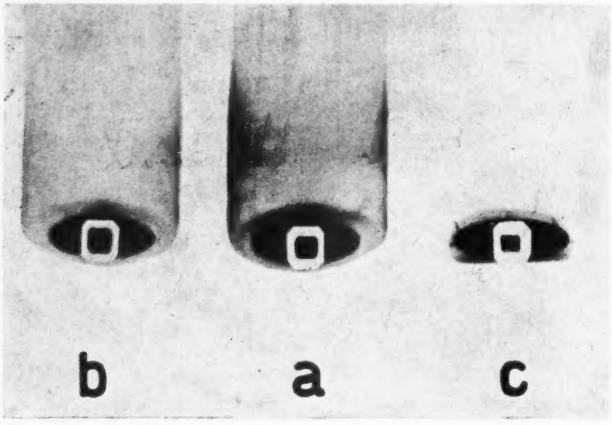

Fig. 6. Pin-hole photographs of the anodes of (*a*) a glass tube, taken without a filter, (*b*) the same tube, using a filter of 10 mm. of Al., (*c*) a Metalix tube, without a filter.

An essential difference between Metalix tubes for deep therapy and those for diagnostics is the metal instead of the glass window. At one point the chromium iron centerpiece is made very thin so that the copper equivalent is about 0.3 mm. Thus it is made impossible to work with a deep therapy Metalix tube without the use of a filter and practically no harm can be done, even should one have forgotten the additional filters for obtaining the desired total thickness.

One of the advantages the Metalix tube affords is the simple manner of mounting it into the apparatus. It is well known that glass tubes have to be mounted rather carefully with the aid of two well insulated holders, one for the anode and one for the cathode neck of the tube. The center part of a glass tube always obtains a somewhat uncertain, mostly negative, high voltage, in which case it is necessary to keep some dis-

of the frequent causes of destruction. With a Metalix tube, however, the part in which the discharge takes place and the X-rays are generated, is all of metal and consequently has a well defined potential. If tubes of the first type (Fig. 1-*A*) are used in conjunction with a transformer which is grounded on one side, this metal part can be grounded, so that no insulating holders are required. In the case of a tube with metal center part the potential of this part, which depends to some extent on the high voltage apparatus which is used, will always be comparatively low, usually a few thousand volts negative. In all cases the Metalix tubes can be mounted with the aid of a simple bakelite tube holder, fitting to a standardized slot which is provided on each tube. In many cases a bakelite cone, adapted to be connected to a similar standardized screw thread on the window, is more convenient and provides a very simple

mounting (see Figs. 8 and 9). Of course, this simplicity is mainly due to the fact that lead or lead glass protecting boxes or shields can be dispensed with.

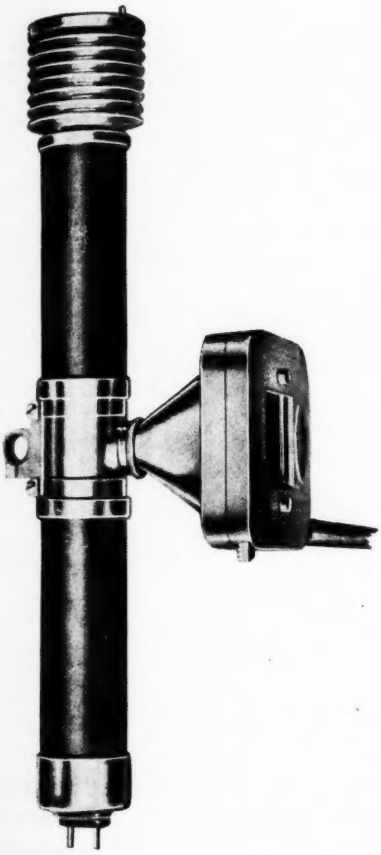

Fig. 7. Showing "the simple manner in which a slot diaphragm for screening purposes can be connected to a tube."

Many constructors in different countries of Europe have designed simplified X-ray apparatus for Metalix tubes. I have the pleasure of showing you four booklets from the most important European countries which contain the simplifications worked out by several firms. In Figure 7 is to be seen the simple manner in which a slot diaphragm for screening purposes can be connected to a tube. Of course, this diaphragm could be made much smaller than would be the case with a glass tube, because it can be arranged at a shorter distance from the

Fig. 8. Showing "a special device (designed by C. H. F. Müller, of Hamburg) for mounting a deep therapy tube with water reservoir and protecting shield against high voltage."

focus. Figure 8 shows a special device (designed by C. H. F. Müller, of Hamburg) for mounting a deep therapy tube with water reservoir and protecting shield against

high voltage. Figure 9 shows a tube mounted on a Potter-Bucky diaphragm.

Quite apart from certain simplifications in X-ray apparatus the Metalix tube has led to some novelties, two of which I should like to describe briefly to you.

As a first novelty I should like to mention the Metalix tube with rotating anode. The idea, or, as is probably more correct to say, the desire to have a tube with movable anode is not novel. A tube with movable anode was even demonstrated by E. Pohl at the International Congress in Stockholm. As we have noted already, the allowable input of an X-ray tube with given focal surface during a given time can be calculated with great accuracy when the construction is known. We can never exceed the limit Nature has set us, and melting or violent evaporation of the anode material would be the result if we tried. The only way to increase the input and, together with it, the output of radiation consists in moving the anode in such manner that while the focus keeps its place the heat is spread over a surface considerably larger than that covered by the focus.

Fig. 9. Showing a tube mounted on a Potter-Bucky diaphragm.

The exterior of a Metalix tube with rotating anode is shown in Figure 10. The nickel cylinder which surrounds the tube contains the field of an electric motor, the armature of which is constituted by the

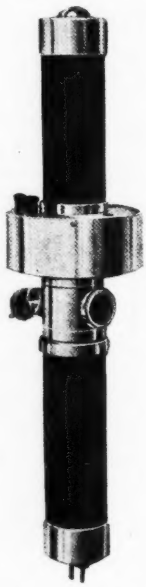

Fig. 10. The exterior of a Metalix tube with rotating anode.

anode itself. Eddy currents in the copper of the anode body are generated by the exterior rotating field, thus forming with it a so-called inductive motor. The latter is a solid copper cylinder which is mounted on special bearings on a molybdenum shaft. At the lower end it is covered by a conical tungsten plate instead of the tungsten "button" used in an ordinary anode. The line focus falls along a descriptive line of this conical surface, so that when the anode is rotated at a sufficient speed the focus, though keeping its place all the time, practically covers the full conical surface of the anode. The very soft roentgenographs which I have the pleasure of showing you were made, all of them, with this type of tube in about 0.05 second and with 200 to

400 ma. at a distance of 1.5 M. This was not the limit of what the tube could stand, and further experiments will have to be made with special and heavier high voltage apparatus. We may expect that it will soon be possible to make satisfactory heart films in 0.02 second, which will probably open up new possibilities—for instance, in the line of X-ray cinematography.

The second novelty is the new portable X-ray apparatus, which combines full protection against high voltage with complete safety as regards radiation.[9] A general idea of the apparatus is shown in the diagram (Fig. 11). The X-ray tube, 3, is a Metalix tube with a metal central part connected to earth. This central part has metallic extensions covering the whole tube, so that the latter is completely enveloped by a grounded metal cover. The center of the secondary windings as well as the cover of the high voltage transformer, 2, is also grounded, as are the flexible metal covers of the high voltage cables, connecting tube with transformer. Thus the whole apparatus is completely enclosed in a metal cover, so that it may be touched during operation without the slightest danger.

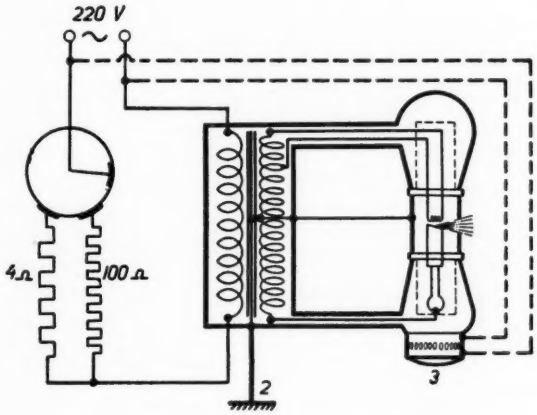

Fig. 11. "The new portable X-ray apparatus, which combines full protection against high voltage with complete safety as regards radiation. A general idea of the apparatus is shown in this diagram. The X-ray tube, 3, is a Metalix tube with a metal central part connected to earth. This central part has metallic extensions covering the whole tube, so that the latter is completely enveloped by a grounded metal cover. The center of the secondary windings as well as the cover of the high voltage transformer, 2, is also grounded, as are the flexible metal covers of the high voltage cables, connecting tube with transformer."

The high voltage is by this arrangement divided up into two equal parts and consequently the insulation problem has been much simplified, for insulation difficulties rise far quicker than proportional to the tension. A spark gap in air, for instance, between points of 6 cm. is equivalent to about 55 K.V., whilst 16 cm. corresponds to about 110 K.V. (peak value). When making use of the principle above, the trans-

[9] See also Bouwers, A., Ned. Tijdschr. v. Geneesk., 1927, LXXII, 756, and Acta Radiologica, December, 1928.

former, the X-ray tube, and the connecting cables can be made of small dimensions and the apparatus can easily be transported in two small cases (Fig. 12). Though we do not pretend that this new apparatus can do everything in diagnostic work, it is evident from the demonstration and the radiographs which may be shown that it affords wider possibilities than one would expect of an instrument of such small dimensions. A splendid skull radiograph, for instance, can easily be obtained in about 5 seconds. Figure 13 shows the apparatus ready for use. The X-ray tube not only affords full protection, but is, moreover, in possession of other special properties, two of which I should like to describe briefly.

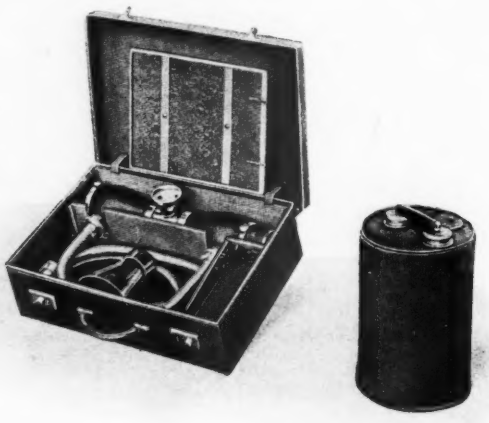

Fig. 12. "The transformer, the X-ray tube, and the connecting cables can be made of small dimensions. The apparatus can easily be transported in two small cases."

In the first place, the focal spot. It is a line focus of extremely small dimensions, the projection in the direction of the radiation having a maximum diameter of about 1.2 mm. Indeed, the surface of the focal spot can be calculated, as current and voltage are invariable and the time of exposure is limited by the special time switch. The small focus combined with the grounded tube cover renders it possible to take X-ray films at much shorter distances than is usual, thus saving a considerable amount of energy, because, as is well known, the required energy is proportional to the square of the distance. For this tube the index of sharpness, according to Heilbron,[10] is about 0.65.

The actual voltage of this apparatus is about 60 K.V. peak and the current about 7 ma., but the special construction of the X-ray tube involves a higher output than would be expected from these figures, for the current-voltage characteristic curve of this tube has an unusual shape. In short, it may be described by saying that a given milliamperage necessitates a relatively high voltage. This is the above-mentioned "space charge effect."

In Figure 14 the currents for the Metalix tube and for a normal Coolidge tube have been plotted for an ordinary alternating voltage, E. If the mean values of both cur-

[10] Fortschr. a. d. Geb. d. Röntgenstr., 1922, XXIX, 297.

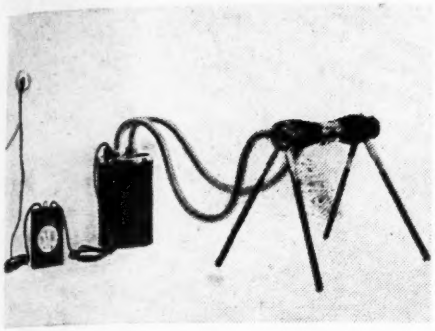

Fig. 13. The apparatus ready for use.

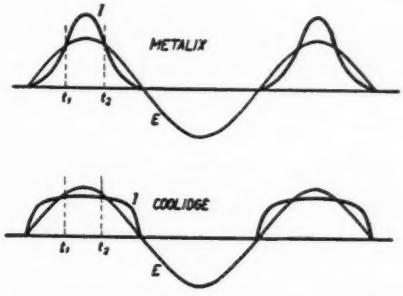

Fig. 14. "The currents for the Metalix tube and for a normal Coolidge tube, plotted for an ordinary alternating voltage, E. If the mean values for both currents are equal, the area between the axis and the current should be equal in both cases. The figure shows clearly that during the period between the moments indicated by the points t_1 and t_2 the current in the case of the Metalix tube has a much higher value than that in the case of the Coolidge tube."

rents are equal, the area between the axis and the current should be equal in both cases. The figure shows clearly that during the period between the moments indicated by the points t_1 and t_2 the current in the case of the Metalix tube has a much higher value than that in the case of the Coolidge tube. Practically, only during this period is the voltage high enough to produce an appreciable amount of X-rays, the radiation at lower voltages being much less both in intensity and hardness. Consequently the output of X-rays obtained from the new Metalix tube is larger than that obtained from a Coolidge tube for a given energy input.

No instruments for measuring voltage and currents are provided in the apparatus in order to obtain the utmost simplicity. The operator, therefore, need not bother about voltage or current. One wants only an exposure table, adjusting the time switch and pressing the button being the only manipulations which are necessary.

The cooling of the anticathode is effected by means of a ventilator, driven by a small motor, fed from the mains. Many X-ray films can consequently be taken in succes-

Fig. 15 The Metalix apparatus functioning out of doors.

sion, while screening can be done without any danger of overheating the anode.

A particularly high saturation of the iron of the transformer, combined with a resistance of about 4 ohms in series with the primary, has the effect that a variation of the primary voltage has very little influence on the secondary, and, therefore, on the quality of the radiation.

A safety device is provided, which prevents the voltage from being switched on before the grounded metal cover of the transformer and the cables have been safely connected, so that there is no possibility of the accessible parts being put under high voltage.

Moreover, a permanent filter of 2 mm. aluminum has been mounted in front of the aperture in order to protect the patient against being hurt by soft radiation. If desired, this filter can be removed by the physician for therapeutic purposes.

I should like to draw your attention to an example of its simple and easy operation. Figure 15 shows the Metalix apparatus functioning in a garden. In this case a small gasoline engine produces the power for an alternating current generator, thus making it possible to take roentgenographs at any place, independent of electrical mains. I will refrain from speaking of the new possibilities opened up by this apparatus for therapeutic use, due to the very small working distance, leaving this subject to the physician. I might, however, mention the fact that according to our measurements an erythema dose can be obtained in a few seconds, provided that no filter is used.

DISCUSSION

MR. E. C. JERMAN (Chicago): I have not had the opportunity of studying this paper previous to its reading, and, as it covers several subjects, it is out of the question for me to attempt to discuss them all in the time at my disposal. I will, then, confine myself to the one part of the subject in which I am, and have been for many years, intensely interested—the matter of protection. Anything which can be done to assist in the protection, especially of those who are constantly employed in the use of the X-ray, is certainly of importance.

I think we have two sources of radiation, from the protection standpoint, that we need constantly to keep in mind: first, that radiation, aside from primary radiation, which emanates above the diaphragm between the tube and the patient, and, second, that radiation, aside from primary radiation, which emanates below the diaphragm. That radiation to which I refer above the diaphragm is usually stray radiation from other parts of the tube than the focal spot. I think the diaphragm is used in practically all modern X-ray equipment.

There are several devices in more or less common use for the protection of the operator from this radiation above the diaphragm, such as the lead glass tube with a transparent window, the lead glass shield or container inside of which the tube is placed with an opening for the passage of primary radiation, and the lead-lined box in which the tube is placed, with an opening for the passage of primary radiation. Probably one method may be as protective as another, but one method may be more convenient than another. It strikes me that this particular device or method involves less weight and may be more conveniently handled. To me, that radiation (secondary radiation) below the diaphragm, which emanates as a result of primary radiation, is a more serious matter.

This secondary radiation emanating from the patient or other substance receiving primary radiation is much more intense than the stray radiation above the diaphragm. I believe, if I am correct, that Dr. Coolidge has stated that the percentage of the radiation which emanates from other parts of

the Coolidge tube than the focal spot is about 9 per cent. The secondary radiation which emanates from the parts receiving primary radiation, and which is scattered throughout the room in which we work, is almost equal in intensity—or, rather, voltage—to that of the primary voltage, and it only needs the use of the fluoroscope to determine or differentiate the difference between these two types of radiation—that above and that below the diaphragm. By placing the tube in a room lead-lined throughout, with an opening through which the primary radiation passes, such a test can easily be made.

I do not mean to belittle in any way protection above the diaphragm, because it is important, of course, but I believe that if we pay more attention to that radiation after it passes through the diaphragm—the secondary radiation, in other words—we will come pretty near to providing protection from stray radiation above the diaphragm. The matter of protection certainly is worthy of careful consideration, and any type of protection which can be made use of, either above or below, is certainly useful. The only fear I had, or the most important feature which came to my mind, in listening to the paper, was that we should lose sight of the importance or forget the importance of protection from that radiation which results from secondary radiation below the diaphragm.

Dr. Hans A. Jarre (Detroit): I hope you will not object when, as one of the first men to use line focus tubes, I say a few words on this subject. I had the pleasure of a long unofficial connection with the firm of C. H. F. Müller, in Hamburg, where I helped a little with the development of the line focus tube. I regard part of the discussion we have heard to-day as an attempt at sidetracking the true issue. We wish, rather, to hear about properties and qualities of tubes and foci and not general rules of protection. We know those. We want to hear about self-protecting tubes and improvement of foci. I am convinced that, if properly used, the line focus tube is far superior to those now in use in this country. I must emphasize—*if properly used*—and not under certain specified conditions which are suitable for one particular purpose only. I have nothing to add so far as the qualities of a self-protecting tube are concerned. I recommend what Dr. Hirsch has pointed out before, that the Society, preferably in co-operation with the other societies devoting their efforts to roentgenology, approach the Government with the request that it remove the prohibitive tariff on all European tubes of the hot cathode type, a tariff which prevents us from importing them at an economic price.

Dr. I. S. Hirsch (New York): I first want to pay my respects to the Dutch genius which made this type of tube possible. In a sense, we are indebted to the Dutch for having given us the man who discovered the X-ray—Röntgen's mother came from Holland—and now we owe them another debt of gratitude because of this development in tube construction, the most radical since Lilienfeld's first demonstration of the hot cathode tube.

I have had experience with three types of Metalix tubes. The radiator and the water-cooled radiographic types of tubes, it seems to me, have many advantages over the hot cathode tubes we have been using for radiography.

First, there is the simplicity of manipulation. You have outwardly a simple metal cylinder which can be easily clamped to any part of your apparatus. One needs no lead shields or lead glass bowls or leaded boxes. The tube is light and needs no heavy counterweighting, and when it comes generally into use it will revolutionize the

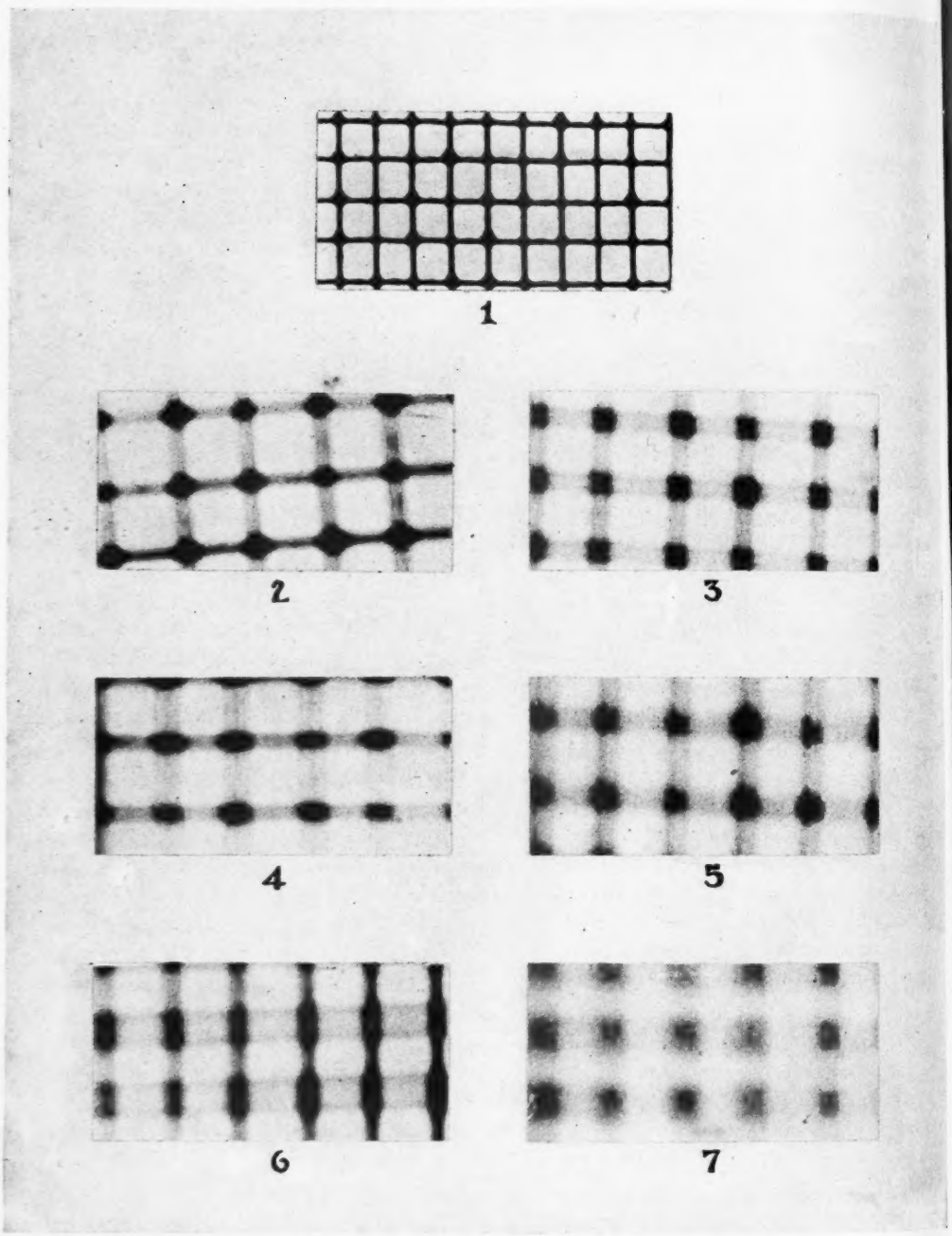

Fig. 1. Mesh.

Fig. 2. Metalix Radiator.
Fig. 3. Coolidge 5-30.
Fig. 4. Metalix W.C. 10 K.W.
Fig. 5. Coolidge Universal.
Fig. 6. Müller 1000 ma.
Fig. 7. Coolidge 5-100.

construction of fluoroscopes, tables, and tube stands. For instance, I use a serialograph plate changer for making twelve exposures on a 14 × 17 film. I have the Metalix tube clamped to the table. It is not an unusual experience for me to make twelve exposures on one film and to repeat that six or seven times in succession day after day. I have had this tube in use for a year and a half and it gives just as sharp radiographs and is just as useful as when first used.

The second point is safety: the tube is safe, safer than are ordinary Coolidge tubes in lead glass bowls. Of course, one has to protect oneself, as Mr. Jerman has just pointed out, from the secondary radiation of the patient; in other words, you cannot throw all protection away. You still have to remain behind the lead screen, but the lead surrounding this tube is quite sufficient to protect one from the direct and indirect radiations emanating from the tube.

Thirdly, its practicability. In a fluoroscope, no dark box or bowl is necessary. The light of the filament itself does not interfere.

Fourthly, its efficiency. The tube belongs to the so-called line focus type, which permits a large amount of energy input and at the same time gives exceedingly sharp radiographs. We made some pin-hole studies of the effective diameters of the focal spots of Metalix, Müller, and Coolidge tubes.

FOCAL SPOT DIAMETERS MEASURED FROM PIN-HOLE CAMERA RADIOGRAPHS

1. Metalix Radiator.....3.5 mm.
2. Coolidge 5-30.....3.5 mm.
3. Metalix W.C. 10 K.W.....4
4. Müller 250 ma.....4
5. Coolidge Universal.....4+
6. Müller 1,000 ma.....6
7. Coolidge 5-100.....6

The diameters of the Metalix Radiator and the Coolidge 5-30 are almost the same, but the Metalix Radiator will take 60 milliamperes at 60 K.V. effective, with no apparent change in focal area.

We also made wire mesh tests of these tubes. It is clear from the radiographs that the Metalix and Müller tubes are far superior to the Coolidge tubes of similar capacity.

The accompanying illustrations (Figs. 1 to 7) show the appearance of wire mesh placed midway between the target and film with the tubes indicated. In the case of the Metalix and Müller tubes the definition is much better in one direction than in the other. This is due to the fact that the ray bundle from these tubes is rectangular, not circular.

From these radiograms and from the focal size determinations mentioned above it is clear that the poorest definition obtainable with a Metalix or Müller tube is far superior to that obtainable with a Coolidge tube of similar capacity.

I think a remarkable development is shown in the rotating target tube with which I have, as yet, had no experience. It will permit an energization almost unlimited, and make possible a great many radiographic maneuvers we have not been able to carry out until now. I have had some experience with the water-cooled therapy tube. We have installed this new tube in one room. It is suspended by a simple clamp from the ceiling, as is the reservoir. In an adjacent room we have the old type of apparatus. It happens to be one of those enormous drums in which the tube has been placed, from which the air is removed by a pump arrangement. Well, it needs only one look into both of these rooms to convince oneself how the whole problem of deep therapy has been simplified. When the tube is energized near 200 K.V., the water in the reservoir steams continually, but the tube operates smoothly with definite certainty, with no marked fluctuation; with 175 K.V.,

constant potential and 2.5 milliamperes of current, it can operate all day with almost constant reading. It is a tremendous advance, it seems to me, to be able to discard all this clumsy paraphernalia in the way of protective shields and enormous tube stands, and simply clamp your tube by a wooden clamp to any portion of your structure and proceed with your treatment. Protection from the secondary radiation must, of course, be afforded.

It is to be regretted that we, in this country, cannot generally avail ourselves of this very great advance in tube construction. We can get these tubes only by subterfuge and with difficulty. When you consider that we are engaged in a humanitarian work, that we desire these instruments not for any material gain but for the purpose of helping the sick in the simplest, surest, and best way possible, such restrictions as are now imposed for any reason whatsoever on the free importation and use of what the best minds in the world have created to help us in our work, I say, are unjust, iniquitous, and unwarranted. I have a feeling that if an organization such as ours presented this problem in its proper light to the authorities in Washington, all such restrictions would be either eased or removed. Something ought to be done in this matter at once. We have been talking about it long enough.

DR. BOUWERS (closing): I wish to thank you for the appreciative words I have heard —I am really very thankful for them. If I may answer one question—or rather, not a question but the words of Mr. Jerman about secondary radiation—I can only emphasize that what he said is quite true, that we have to take care of secondary radiation. But we have tested the intensity of the radiation in a number of X-ray rooms with bad protection boxes and we have also measured the intensity in X-ray rooms with the Metalix tube and found that radiations in these cases were of entirely different order. I shall try to publish some exact figures in RADIOLOGY, but I may say now that in many cases the secondary radiation was of comparatively no importance, as fifty or a hundred times more primary radiation was present on account of insufficient protection. On the other hand, if you know that the only source of radiation in the room is the patient himself, where he is hit by the radiation, one lead screen will do between the patient and yourself to accomplish perfect safety.

SURGICAL PROCEDURES IN CARCINOMA OF THE RECTUM[1]

By FRED W. RANKIN, M.D.,

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THE treatment of carcinoma of the rectum, whether by operation, radium, or roentgen ray, or a combination of these agents, is a vital problem, not only because of the complex nature and likelihood of complications of the malignancy itself, but because of the apparent increase in incidence of carcinoma in this situation. My personal experience in the treatment of carcinoma of the rectum has been entirely surgical, and yet my colleagues at The Mayo Clinic in the radiologic department are being called on more frequently to co-operate in the palliation in inoperable cases, and, in operable cases, in the application of radium or roentgen-ray treatment in the hope that its use may prevent more distant recurrences.

At The Mayo Clinic the cases of carcinoma of the rectum have been arbitrarily divided into two distinct groups, the operable and the inoperable, the former being universally recommended for surgical procedures and the latter treated either by a palliative operation, radium and roentgen ray, or by radium and roentgen ray alone. Thus, all cases which are extirpable have been considered as surgical cases except the extremely occasional case in which operative interference is refused, under which circumstance radium or roentgen ray, or both, have been applied.

In the selection of cases for operation and for treatment by radium, I believe we may meet on more common ground as a better understanding of the treatment, operability, and intensity of malignancy is reached. Unquestionably, the situation of the carcinoma in the upper part of the rectum or rectosigmoid influences markedly the operative procedure indicated, and, likewise, in case operation is merely a palliative measure, or in the event that the application of radium is deemed more advisable, the situation of the growth influences the ease and technic of application as well as the possibility of destruction of the growth by radium, since direct visual application proctoscopically undoubtedly is the most advantageous means of obtaining its maximal benefit.

Surgery in carcinoma of the rectum offers palliation in certain inoperable cases and cure in a high percentage of cases in which radical extirpation of the offending growth may be satisfactorily carried out. Radical surgical procedures offer the greatest chance of cure in the largest number of cases, the prognosis depending on many factors, the most important of which are the age of the patient, extent of time the lesion has been present, amount of fixation to adjoining tissues, presence or absence of metastasis, and the intensity of the malignancy. Carcinoma of the rectum, like carcinoma of other parts of the gastro-intestinal tract, usually is of the glandular type, but occasionally a squamous-cell epithelioma or epidermoid carcinoma is found. The latter type most usually is situated around the anus and the explanation for its origin is the same as that of epithelioma of the stomach or gall bladder, the regenerative cells of the glandular epithelium in these organs having the power to produce either a secretory or a protective epithelium. Occasionally a melano-epithelioma is found just inside the anal canal. Adenocarcinoma is present in the rectum in all of its forms, namely, papillary, polypoid, mucoid, ulcerating, infiltrating, "napkin-ring," and so forth. The presence of infection and degeneration, as well as ulcera-

[1]Read before the Radiological Society of North America, at Chicago, Dec. 3 to 7, 1928.

tion, is almost universally noted. The differentiation of the cells in adenocarcinoma of the rectum, and their arrangement in glandular or acinous formation, indicate the intensity of the malignancy. It has been the custom in the Clinic to grade all these carcinomas according to Broders' grading of malignancy, a decision which has been of enormous help in arriving at a prognosis in this type of case.

Broders' index of malignancy, the result of many years' study of more than 2,000 malignant growths, has resulted in their being graded in four different degrees of malignancy. The basis of the index depends on the fact that the more a neoplastic cell is differentiated or approaches in structure a normal cell, the lower its degree of malignancy, and, conversely, the more malignant the tumor, the more differentiated or embryonic are its cells. In carcinoma, graded 1, about three-fourths of the structure contains differentiated cells and about one-fourth contains undifferentiated cells, while in malignancy, graded 4, practically all the cells are undifferentiated. Between these two extremes, Grades 2 and 3 rest, the former containing about one-half differentiated and one-half undifferentiated cells, and the latter containing about one-fourth differentiated and three-fourths undifferentiated cells. I do not believe that any other advance in pathology of recent years has been so important from the standpoint of prognosis as this significant work of Broders', which has been repeated and substantiated by Martzloff.

The origin of a great many carcinomas of the rectum undoubtedly is in adenomatous polyps and small adenomas which are frequently found in the large bowel. A striking example of the incidence of malignancy developing on multiple polyps is seen in colons which are the site of these huge, multiple, pedunculated polyps through their entire length. In approximately 50 per cent of such ailments, malignant degeneration results, even in young persons. Only recently I operated on a girl aged twenty-two with a history of symptoms dating back only six months. At exploration I found multiple polyps with two degenerating areas, one at the splenic flexure and one at the hepatic flexure, with definite metastasis to the liver. The change from benign adenomas to malignancy takes place more often at the periphery than at the base, and mitotic figures may or may not be numerous, showing advanced differentiation.

Metastasis to the liver, of course, rules out operative interference, and only palliative measures, either surgical or otherwise, may be offered to such sufferers. On the other hand, it is not necessary to consider all fixed or adherent carcinomas of the rectum or large bowel as inoperable in the absence of metastasis to the liver, because huge technical feats are frequently possible with satisfactory end-results, especially if the growth is of a low grade of malignancy. I am confident that fixation of rectal and rectosigmoidal carcinomas in most instances is due more often to inflammatory changes around the growth than to adhesion, and frequently, following drainage operations and local applications of medicaments to the growths to reduce the infection, one finds a supposedly inoperable growth to be resectable and often curable. The presence of malignantly infected lymph nodes obviously reduces the chances of a satisfactory outcome. On the other hand, until the node is subjected to microscopic examination, the presence of malignancy may not be arbitrarily asserted. Palpation in most instances reveals a hard, shotty node in immediate juxtaposition to a carcinomatous growth, but frequently hard lymphatic growths are found microscopically to be inflammatory.

Unquestionably, the best outlook in the surgical treatment of carcinoma of the rectum attends that favorable group of cases in

which operation may be performed early, the growth is movable, the lymphatics are not involved, and after resection has been performed, the growth is found to have invaded only the musculature of the colon. The mortality following operation in this group is low, the end-results are satisfactory, and the percentage of cures high. This is the group in which one expects cures of five or seven years, or even longer. The operative mortality should be around 5 per cent, regardless of the type of operation employed and provided an adequate and sensible selection of cases is made.

Fortunately, in all carcinomas of the rectum, metastasis is a slow process and lymphatic involvement does not occur early. This fact alone urges one to undertake many advanced cases in the hope of eradicating the local malignancy entirely. Obstruction and blood in or on the stool are the most common symptoms which send a patient to a physician for examination. Obstruction is most common at an early stage in rectosigmoidal carcinoma because here the bowel normally is smaller in lumen and because fixation to the promontory of the sacrum is the rule. Increasing constipation and difficulty in defecation early call attention to a pathologic process in the bowel and urge investigation. Growths at the rectosigmoidal juncture demand an entirely different type of treatment surgically and are the most inaccessible for local applications of radium of any growths in the lower portion of the bowel.

In cases of inoperable carcinoma, surgical procedures are usually confined to a drainage operation which either relieves obstruction only or relieves obstruction and permits the application of radium through the colostomy opening. Colostomy, either as a single stage of a graded operation or as an adjuvant to subsequent treatment, frequently is a problem not readily decided. An artificial anus, placed anteriorly, uncontrollable, and, at the same time, visible to the eye, is a harassing combination for most patients unfortunate enough to need it. On the other hand, with satisfactory care and a little patience, one may frequently have a comfortable existence not incompatible with social or professional duties to which one was formerly accustomed.

Colostomy as an aid to the application of radium in inoperable or borderline cases is essential only in the presence of obstruction or of rectosigmoidal growth. It seems certain that direct application of radium to the growth under visual guidance is the ideal way to use it and in a case in which a colostomy opening has been made through which the radium may be applied to a rectosigmoidal growth or through which irrigations may be made to reduce local infection, it is essentially a satisfactory procedure even though palliation is all that is aimed at. It is often difficult to decide in a given case of rectal carcinoma whether colostomy should be performed in the absence of marked obstruction, or whether local treatment should be applied proctoscopically. My own opinion is that if the growth is inoperable the application of radium without colostomy is perhaps more satisfactory in a greater number of cases, provided obstruction is not a prominent feature. Persons who have metastasis to the liver die comfortably and painlessly unless the local growth attaches itself to some vital organ, such as the bladder, or metastasizes to the spine, and for this reason colostomy in unobstructed growths is not universally indicated. On the other hand, if obstruction is imminent, a separate drainage procedure is decidedly advantageous. It should be noted that the initial action of radium produces edema and inflammatory changes, which in the presence of marked obstruction may change this narrowing to complete stenosis. I have twice been called on to perform colostomy following local application of radium to advanced

carcinomas of the rectum which produced such reaction as to shut off completely the lumen of the bowel.

That the end-results following radical surgical procedures in combination with other therapeutic agents compare favorably with the end-results in carcinoma anywhere else in the body is undeniable. In a group of 598 cases of carcinoma of the rectum recently studied at The Mayo Clinic, the malignancy being graded after Broders' method, it was found that the percentage of cases in which metastasis was present increased in direct proportion to the grade of malignancy and absence of metastasis increased in inverse proportion to it. The grade of malignancy was found also to influence the ultimate result following operation, the percentage of total good results decreasing in inverse proportion to the grade of malignancy and the percentage of total bad results increasing in direct proportion to it. In the cases in which metastasis was present, the total of good results was 20.68 per cent; the total of the poor results was 79.31 per cent. In the cases in which metastasis was absent, the total of good results was 57.87 per cent; the total of poor results was 42.12 per cent. In this group of cases it was also found that the results obtained in cases in which malignancy was graded 1, with metastasis, were almost as good as in cases in which malignancy was graded 3 and 4, without metastasis. The results obtained in cases in which malignancy was graded 4 and metastasis was present were very poor. In this series the average duration of life after operation was influenced by the grade of malignancy, as shown by the fact that the average duration decreased as the grade of malignancy increased.

It seems to me that the essential feature of the treatment of carcinoma of the rectum is the diligent application of all therapeutic measures available for its eradication and prevention of recurrence. Better understanding of the intensity of malignancy by the application of Broders' grading unquestionably will aid in the selection of cases for treatment by operation or radium or a combination of both. The fact that has been emphasized by Bowing that high-grade malignant growths, graded 3 and 4, are more radiosensitive than those graded 1 and 2 urges the application of this agent to such growths, either pre-operatively, without operation, or post-operatively, both as palliation and cure. Co-operative management has reduced the operative mortality to a reasonable percentage and has permitted the extension of radical measures in extirpation. Similarly, a better understanding of the uses, indications, and reactions of radium and roentgen ray will permit segregation of suitable cases, which will assist in the development of more hearty co-operation between the surgeon and radiologist in combating this unfortunate condition.

THE X-RAY EXAMINATION OF THE HEART IN BERIBERI

By CHESTER S. KEEFER, M.D., and C. K. HSIEH, M.D., PEPING, CHINA

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FOR some time, we have been interested in following the changes which occur in the size and configuration of the heart in patients with beriberi. One of the best methods of doing this is by means of repeated teleoroentgenograms.

In this paper we wish to present the results of a roentgenologic study of the heart in patients with beriberi. Some had symptoms of cardiac insufficiency, others had not.

METHODS OF STUDY

The patients were all resident in the hospital. The clinical course and treatment have been described in detail elsewhere (1). The patients were examined with the fluoroscope in order to determine the position and mobility of the diaphragm, the movement of the heart, and condition of the retrocardiac space as viewed in the oblique positions.

Teleoroentgenograms were made at different intervals during the course of the illness. The changes in the size and configuration were noted. The level of the diaphragm, the transverse diameter, and the width of the shadows at the base were measured. The surface area of the heart was also determined and compared with the calculated normal, according to the method described by Hodges and Eyster (2).

RESULTS

The results of the measurements of the heart in patients with and without cardiac insufficiency are recorded in Tables I and II. The changes in the size and configuration of the heart can also be followed by referring to Figures 1, 2, 3, 4, 5, and 6. The latter, a single examination, is presented to illustrate the configuration which is common, and which may be confused with that of mitral valvular disease.

Diaphragm.—We did not observe paralysis of the diaphragm in any of our cases. The position of the two sides of the diaphragm was normal, and any change in the

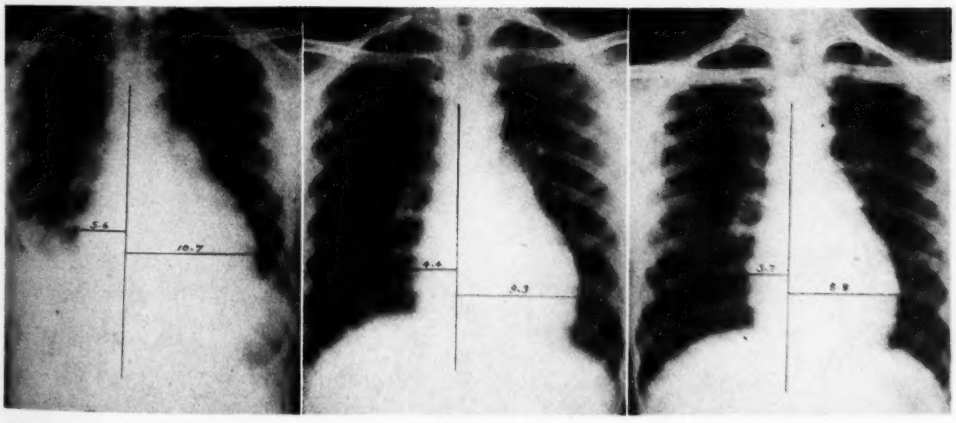

Fig. 1. First day of observation. Fig. 1-*A*. Eighth day of observation. Fig. 1-*B*. Sixteenth day of observation.

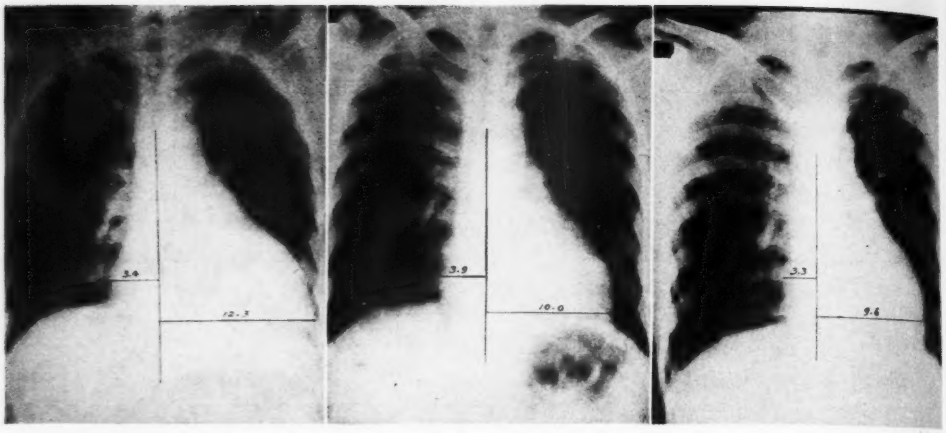

Fig. 2. First day of observation. Fig. 2-*A*. Fourteenth day of observation. Fig. 2-*B*. Twenty-fourth day of observation.

configuration of the heart which was noted could not be attributed to a change in the level of the diaphragm.

Heart Size.—The examination of the heart of patients with cardiac insufficiency (see Figs. 1, 2, 3, 4) showed that it was enlarged to both the right and left of the median line. There was enlargement of both the right auricle and ventricle, and an increase in the width of the shadow in the region of the pulmonary artery. This latter shadow was due to an enlarged conus arteriosus, pulmonary artery, and right ventricle. The heart was enlarged outward and upward, and assumed the form characteristic of right-sided cardiac enlargement.

There was also enlargement of the shadow at the base of the heart, due to a dilated superior vena cava. With the dilatation of the right auricle, the shadow cast by the superior vena cava becomes more conspicuous. This is well illustrated in Figures 1 and 5.

The transverse diameters varied from 11.8 cm. to 16.3 cm. The heart size when compared with the calculated normal varied

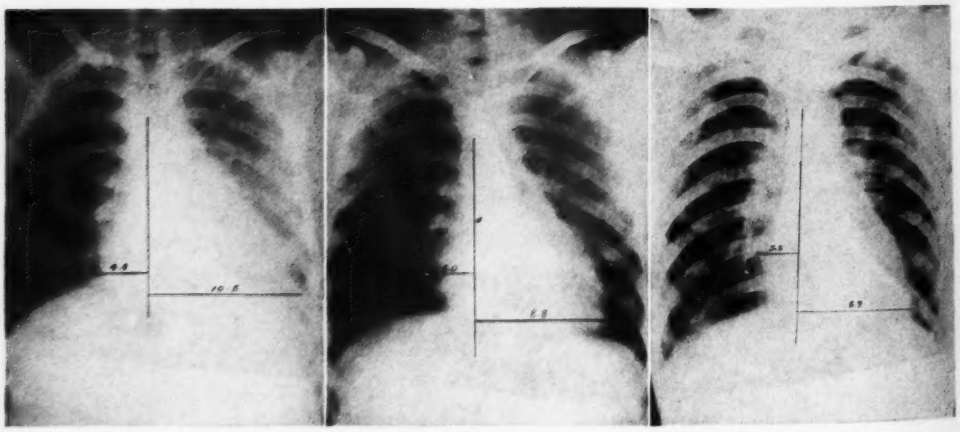

Fig. 3. First day of observation. Fig. 3-*A*. Seventh day of observation. Fig. 3-*B*. Twenty-fourth day of observation.

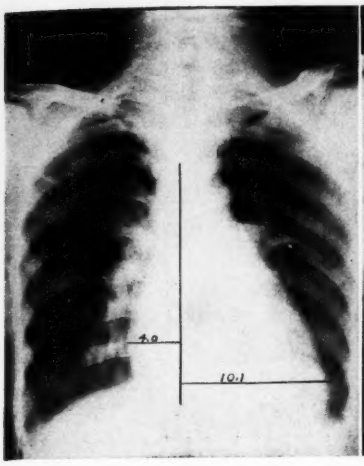

Fig. 4. First day of observation.

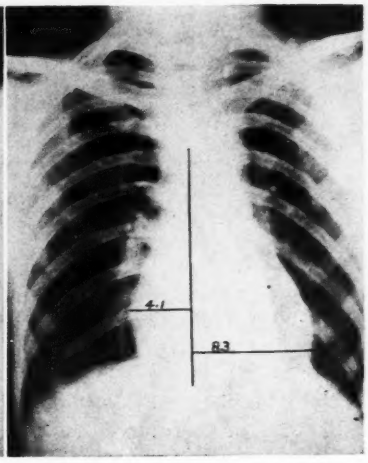

Fig. 4-*A*. Fifteenth day of observation.

from 20 to 51 sq. cms. above normal. Pleural effusion was present in four cases. The lung fields in the other cases were clear.

The left auricle and ventricle were not conspicuously enlarged when examined in the right and left anterior oblique positions.

During the course of the disease, the most dramatic changes occurred in both the size and configuration of the heart. Following rest in bed and anti-beriberi diet, supplemented by yeast, the size of the heart diminished rapidly, the shadows at the base became less conspicuous, and the heart assumed its normal configuration.

In some patients the heart did not become normal in size for from six weeks to two months, in others the size diminished within from seven to ten days.

The patients without cardiac insufficiency frequently show cardiac enlargement (see

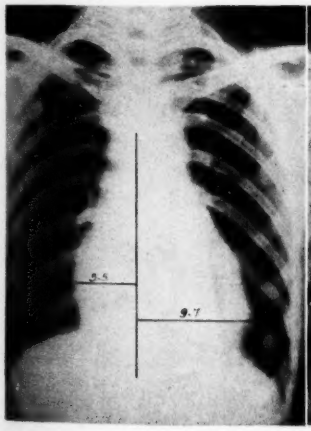

Fig. 5. First day of observation.

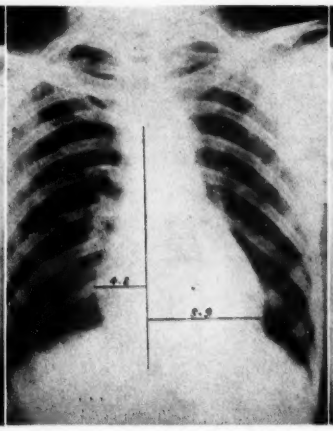

Fig. 5-*A*. Fifth day after beginning treatment.

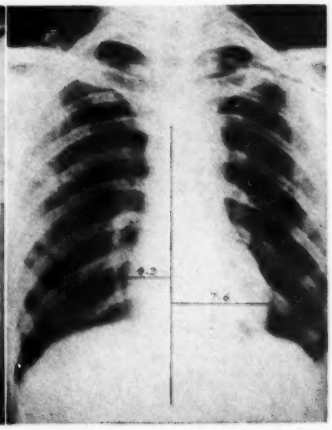

Fig. 5-*B*. Fifteenth day after beginning treatment.

Table I

X-ray Examination of Heart in Beriberi Patients with Signs of Cardiac Insufficiency

Case	Day of Observation	Diaphragm			Transverse Diameter			Heart Area				
		Fluoroscopic examination	Position right	Position left	M. R.	M. L.	Total	Estimated normal	Measured area	Oversize	Aorta	Remarks
1	1st day	Movement normal	10th rib	10th rib	5.6 cm.	10.7 cm.	16.3 cm.	107.56 sq.cm.	157.3 sq.cm.	49.74 sq.cm.	6.4 cm.	Pleural effusion.
	8th day	" "	10th rib	10th rib	4.4 cm.	9.3 cm.	13.7 cm.	104.07 sq.cm.	131.9 sq.cm.	27.83 sq.cm.	5.9 cm.	
	16th day	" "	11th rib	11th rib	3.7 cm.	8.9 cm.	12.6 cm.	104.01 sq.cm.	124.8 sq.cm.	27.9 sq.cm.	5.6 cm.	
2	1st day	Movement normal	10th rib	.....	3.4 cm.	12.3 cm.	15.7 cm.	98.11 sq.cm.	132.0 sq.cm.	44.1 sq.cm.	5.5 cm.	
	14th day	" "	10th rib	10th rib	3.9 cm.	10.0 cm.	13.9 cm.	96.0 sq.cm.	118.5 sq.cm.	22.5 sq.cm.	4.0 cm.	
	24th day	" "	10th rib	10th rib	3.3 cm.	9.6 cm.	12.9 cm.	96.0 sq.cm.	118.2 sq.cm.	21.0 sq.cm.	4.8 cm.	
3	1st day	Movement normal	9th rib	.....	4.9 cm.	10.5 cm.	15.4 cm.	98.56 sq.cm.	124.0 sq.cm.	25.44 sq.cm.	6.0 cm.	
	7th day	" "	9th rib	10th rib	4.0 cm.	8.8 cm.	12.8 cm.	98.56 sq.cm.	106.5 sq.cm.	10.0 sq.cm.	4.8 cm.	
	24th day	" "	10th rib	10th rib	3.2 cm.	8.9 cm.	12.1 cm.	96.0 sq.cm.	106.5 sq.cm.	10.0 sq.cm.	4.8 cm.	
4	1st day	Movement normal	10th rib	.....	4.0 cm.	10.1 cm.	14.1 cm.	104.01 sq.cm.	126.2 sq.cm.	22.0 sq.cm.	4.8 cm.	
	15th day	" "	10th rib	11th rib	4.1 cm.	8.3 cm.	12.4 cm.	104.01 sq.cm.	106.3 sq.cm.	2.0 sq.cm.	5.0 cm.	
5	1st day	.....		8th rib	3.8 cm.	8.4 cm.	12.2 cm.	.....	.....	.....	.....	Pleural effusion
	27th day	.....	9th rib	10th rib	3.0 cm.	7.5 cm.	10.5 cm.					
6	1st day	Movement normal	9th rib	10th rib	5.2 cm.	10.2 cm.	15.4 cm.	95.1 sq.cm.	146.5 sq.cm.	51.0 sq. cm.	5.5 cm.	
7	1st day	.....	9th rib	.....	5.5 cm.	.....	.....	.....	.....	.....	.....	Bilateral effusion
	14th day	.....	9th rib	10th rib	6.4 cm.	7.7 cm.	14.1 cm.	92.0 sq.cm.	99.0 sq.cm.	7.0 sq.cm.	5.0 cm.	Pleural effusion (left-sided).
8	1st day	Movement normal	.....	8th rib	3.8 cm.	8.0 cm.	11.8 cm.	.....	.....	.....	.....	Pleural effusion

TABLE 11

X-RAY EXAMINATION OF HEART IN BERIBERI PATIENTS WITHOUT SIGNS OF CARDIAC INSUFFICIENCY

Case No.	Day of Observation	Diaphragm			Transverse Diameter			Heart Area				
		Fluoroscopic examination	Position right	Position left	M. R.	M. L.	Total	Estimated normal	Measured area	Oversize	Aorta	Remarks
1	1st day 5th day 15th day	Movement normal " " " "	10th rib 10th rib 10th rib	11th rib 11th rib 11th rib	5.5 cm. 4.8 cm. 4.2 cm.	9.7 cm. 8.9 cm. 7.6 cm.	15.2 cm. 13.7 cm. 11.8 cm.	103.48 sq.cm. 103.48 sq.cm. 102.80 sq.cm.	148.0 sq.cm. 121.3 sq.cm. 92.9 sq.cm.	45.4 sq.cm. 17.8 sq.cm. 10.0 sq.cm.	6.6 cm. 6.4 cm. 6.5 cm.	
2	1st day	Movement normal	10th rib	10th rib	5.0 cm.	9.5 cm.	14.5 cm.	96.18 sq.cm.	134.5 sq.cm.	38.0 sq.cm.	4.7 cm.	
3	1st day	Movement normal	10th rib	11th rib	4.3 cm.	8.7 cm.	13.0 cm.	102.61 sq.cm.	107.9 sq.cm.	5.3 sq.cm.	4.7 cm.	
4	1st day	Movement normal	10th rib	10th rib	3.3 cm.	8.1 cm.	11.4 cm.	94.33 sq.cm.	89.0 sq.cm.	5.0 sq.cm. under size	4.3 cm.	
5	1st day	Movement normal	10th rib	11th rib	5.0 cm.	7.8 cm.	12.8 cm.	.....	.....	.....	5.2 cm.	
6	1st day	Movement normal	10th rib	9th rib	3.2 cm.	8.6 cm.	11.8 cm.	.....	.....	.....	.....	
7	1st day 11th day	Movement normal " "	10th rib 10th rib	11th rib 10th rib	4.0 cm. 3.5 cm.	7.0 cm. 7.0 cm.	11.0 cm. 10.5 cm.	.....	.....	.....	.....	
8	1st day	Movement normal	10th rib	10th rib	3.0 cm.	8.1 cm.	11.1 cm.	.....	.....	.....	.....	

Figs. 5 and 6), although not as constantly as in the patients with heart failure. (See Table II.)

Previous observations of the roentgenologic findings of the heart in beriberi have been recorded by Reinhard (3), Aalsmeer

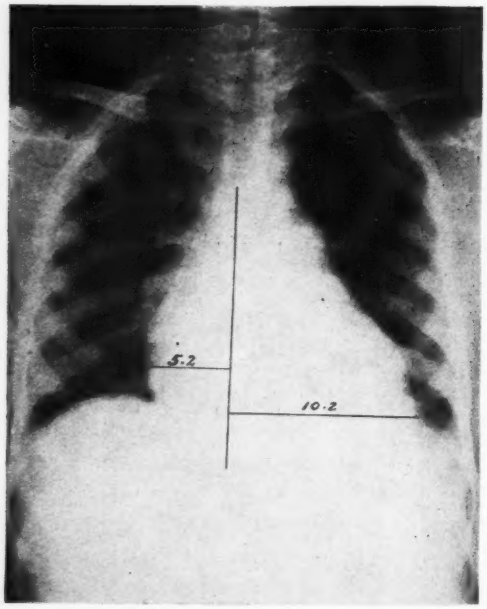

Fig. 6.

and Wenekebach (4), Miura (5), Ido and Watanabe (6), and Kepler (7). All of these authors emphasize the fact that there is considerable right-sided enlargement and that the heart decreases in size following specific therapy.

SUMMARY AND CONCLUSIONS

(1) The heart was enlarged in all cases of beriberi with cardiac insufficiency.

(2) There was considerable cardiac enlargement in some patients without cardiac insufficiency.

(3) The enlargement was principally right-sided, involving both the right auricle and ventricle, and the pulmonary artery was quite prominent in many.

(4) There was enlargement in the region of the superior vena cava. This shadow diminished with the decrease in the size of the right auricle. The left auricle and ventricle were enlarged to a lesser degree.

(5) The size and configuration of the heart changed completely following treatment, and assumed a normal size and shape after a varying length of time.

BIBLIOGRAPHY

(1) Keefer, C. S.: The Beriberi Heart. Arch. Int. Med. (In press).

(2) Hodges, P. C., and Eyster, J. A. E.: Estimation of Cardiac Area in Man. Am. Jour. Roentgenol. and Rad. Ther., September, 1924, XII, 252.

(3) Reinhard, P.: Röntgenbefunde bei beriberiartigen Erkrankungen. Arch. f. Schiffs- und Tropenhyg., 1916, XX, 1.

(4) Aalsmeer, W. C., and Wenekebach, K. F.: Herz und Kreislauf bei der Beriberi Krankheit. Wien. Arch. f. inn. Med., January, 1929, XVI, 193.

(5) Miura, K.: Beriberi oder Kakke. Ergebn. d. inn. Med. u. Kinderh., 1909, IV, 280.

(6) Ido, Y., and Watanabe: The Orthodiagraphic Examination of the Heart in Beriberi. Jour. Tokyo Med. Ass., XXVII, No. 22.

(7) Kepler, E. J.: Beriberi from a Diet of Raw Starch. Jour. Am. Med. Assn., Aug. 8, 1925, LXXXV, 409.

THE VALUE OF ROENTGENOLOGIC EXAMINATIONS IN OTOLARYNGOLOGY[1]

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THE modern, practical, and scientific otolaryngologist must to-day look upon roentgenologic examination as an indispensable adjunct to his diagnostic armamentarium. To be without the services of an expert radiologist places the otolaryngologist in a position equivalent to that he would have occupied in practising his specialty a decade or more ago. We must always be grateful to the early pioneers in X-ray work, who experimented with and perfected the different technics which now contribute so much to the diagnosis of pathologic conditions in the ear, nose, and throat. Without this aid, diagnoses would, on numbers of occasions, be inaccurate and even impossible.

The sinuologist who attempts diagnoses and pre-operative examinations without the aid and assistance of the radiologist has not worked up his cases properly and should under no conditions attempt to operate. On the other hand, we must not go to the opposite extreme and expect the X-ray findings to make the diagnosis for us. It is only through the proper correlation of our clinical and radiological findings that we can and should arrive at our diagnoses. Just at this point let me stress the fact that written reports of X-ray findings can never, under any circumstances, equal the shadow-box examination of the plates by the otolaryngologist himself, in co-operation with the radiologist. The discussion of the plate, from the clinical point of view by the surgeon and from the X-ray point of view by the roentgenologist, will often clear up hazy and difficult problems of diagnosis. If it is impossible to hold such a conference, the rhinologist should become proficient in the reading of his plates and should insist that all plates accompany the written report of the radiologist. We must not stop here, but, in the words of Shea, "We should give the roentgenologist the advantage of the knowledge obtained by a post-operative reading of the plate. 'Reading into' a post-operative picture can be the means of 'reading out' of future picture findings that would otherwise have been missed." As an example: About two years ago, while examining an X-ray film of the sinuses, we noticed a definite rounded shadow in one of the antra, which we were at a loss to explain satisfactorily. Post-operatively, we knew definitely that this shadow was due to a large pedunculated polyp lying on the floor of the antrum, and this observation has been exceptionally useful on several occasions since. This can all be summed up by quoting an article of Grier's, which appeared in 1925:

"There is probably no other branch of roentgenology that has passed through such a trying period in an effort to gain a little knowledge. The main reason for the difficulties which have been encountered and the mistakes which have been made has been a lack of knowledge of roentgenology on the part of the rhinologist and an utter ignorance of rhinology on the part of the roentgenologist. Up to the present, little attempt has been made to rectify this serious drawback. The rhinologist has apparently been content to relegate the X-ray to a very minor place in sinus diagnosis; and the roentgenologist has a very confused idea as to just what the surgeon expects from him and how he can be of assistance. The

[1]Read before the Radiological Society of North America at the Thirteenth Annual Meeting, at New Orleans, December, 1927.

whole situation needs to be very carefully gone into in an effort to find some common ground on which the two specialists can meet. It seems improbable that the greatest good can be obtained either by the rhinologist reading his own plates, or by the roentgenologist attempting to make the diagnosis. In the first instance, a lack of knowledge of roentgenological findings in general and an experience limited to the practice of one individual, even if large, would seriously handicap a rhinologist acting as his own roentgenologist. In the second instance, the roentgenologist is more seriously handicapped than his confrère, as a complete diagnosis can seldom, if ever, be made without the history, symptoms, and physical findings. As an illustration of this point, I would call attention to the fact that an antrum filled with pus as the result of an acute infection, a condition which has perhaps been present for a week or so, looks no different on a roentgenogram from an old chronic empyema of the antrum which has possibly been present for years. However, from the standpoint of the rhinologist, I assume that the differentiation must be quite important. If sinus roentgenology is ever to become the valuable adjunct in diagnosis which I believe is possible, the roentgenologist must have a better knowledge of sinus pathology and must understand more definitely from the rhinologist just what he expects to find out from the X-ray examination. The rhinologist on his part can greatly aid the roentgenologist by giving him more operative findings, so that he may gradually accumulate positive knowledge that certain definite X-ray findings accompany specific pathology as demonstrated on the operating table."

We should have our plates made, always, if possible, by the same radiologist, or by radiologists who at least use the same technic for taking the plates. In this way only can we become proficient in interpreting what we see, and we otolaryngologists will not be prone to shift the responsibility to the radiologist for the final diagnoses in our difficult cases.

Various technics have been adopted for the taking of sinus plates and different men have different ideas as to their usefulness and accuracy. No matter what your preference is, learn to interpret your findings correctly, and be sure that your method shows all that can be shown. Most of the rhinologists in New Orleans are partial to the Granger technic, and it is right that they should be, for we feel that by this method we are getting the most out of our examinations. If any criticism of the method can be made, it is that at times it shows too much, and may be confusing to the beginner in this particular method. By all means insist on a lateral view of every case of suspected sinus infection, for frequently remote lesions, such as brain tumors, gummas, pituitary disturbances, etc., give evidences of intracranial pressure or changes in the bones of the skull which will clear up some obscure diagnosis. Again a lateral view, as brought out by Dupuy, will give us an opportunity to measure the distances of the anterior wall and posterior wall from the anterior nasal spine. This is an invaluable aid, particularly in those cases where a large posterior ethmoid cell almost completely hides the anterior sphenoidal wall. In operating, we may get into this cell and feel certain that we are in the sphenoid, when, as a matter of fact, we have not even entered the anterior surface. Some months ago a case presented itself that admirably showed the advantages of these measurements. Several rhinologists were shown a case, during an operation, and they all readily agreed that the sphenoid sinus was wide open, yet, upon measuring, we found that only the anterior wall had been reached and the sinus had not been opened at all. Knowing the distance of the posterior wall, a punch forceps was pushed through the anterior surface without any hesitancy and the deep cavity of the sphenoid found. Since this experience, the question of how many posterior ethmoid

cells are opened for the sphenoid has constantly been in our minds.

The Granger position for sinuses has advantages, to my mind, not obtained by any other method. This can best be illustrated by the following case:

Female, aged 43 years, was admitted to the hospital with a temperature of 104 degrees, high leukocyte count, cellulitis of the left side of the face and complete occlusion of the left naris. The nose was so completely blocked that it was with difficulty that cotton and cocaine-adrenalin packs could be placed. *Clinical diagnosis:* Pansinusitis, with rupture of antral wall and pus in cellular tissue of cheek. *Roentgen findings:* The left sphenoid is opaque in both the Pfahler and Pirie films. *Roentgen diagnosis:* Pathology of left sphenoid. In the Granger film the G-line is clearly visible on the left side; less dense and not so clearly outlined on the right side. *Roentgen diagnosis:* No pathology of left sphenoid. Hyperplastic sphenoiditis on the right side. The sphenoid appears quite clear in the lateral film. *Operative findings:* Pus found in left frontal, maxillary, and ethmoids, but no pus in left sphenoid. It did not seem possible that the sphenoid could escape infection with the amount of pus present in all other sinuses and the inadequate drainage, and for this reason the sphenoid was opened. The right sphenoid was later opened and a hyperplasia of the mucous membrane found.

It is surprising how many cases of obsure headache will show a hyperplastic change in the sphenoid by the Granger method, when all other methods are negative. At this point let me sound a warning, that every case of hyperplastic sphenoiditis that we see in the roentgenogram does not have to be operated upon, and a number of these cases will clear up under proper medical treatment. The use of lipiodol, injected into the sinuses, has not been very successful in my hands, and at the present time I have discarded it. Possibly with further efforts and study it will be of some service. In using the Proetz method of getting lipiodol into the posterior ethmoids and sphenoids, I have never been successful in a pathologic case. This may be due to some error in technic, but I am inclined to believe that with a marked hyperplasia of the mucous membrane of the sphenoids, the normal opening is closed, partially at least, and it is a difficult problem to get your oil through this opening by air displacement only. This method seems to have been quite satisfactory in the hands of Proetz. By the injection method, I have been able to demonstrate, on several occasions, a large posterior ethmoid cell, placed directly in front of the sphenoidal wall.

In nasal fractures it is always a good policy to make roentgenographs, for imperfect apposition can be seen quite readily and it is at times difficult to gauge the apposition of the fragments by palpation, particularly when one sees his cases after swelling and ecchymosis have set in.

Again, in the field of otology the value of roentgenology is unquestioned. For our purposes at Charity Hospital we use both the Law and the Arcelin positions. In the Law position the plate shows clearly the posterior canal wall and the anterior sinus wall, and gives a very fair idea of the distance that separates them. The periantral cells can be fairly well made out, but the zygomatic and tip cells are merged. In the Arcelin position the superior semicircular canal, the internal and auditory canals, the middle ear, and the periantral, zygomatic, and tip cells can be clearly seen. It seems almost useless to say that both mastoids should be taken, so that the diseased can be compared with the normal side. At times the repeated X-ray examination of a mastoid will show the progress or arrest of the infection and will be a valuable aid in our decision as to whether or not to operate. A haziness of

the field is indicative of a congestion or hyperemia, but as the cell trabeculæ are gradually destroyed and the walls break down and there is a marked clouding of the view, we know that a purulent exudate has formed. The Arcelin position has been quite serviceable in distinguishing an external otitis from a true mastoiditis. As an example of this, Granger reported one of my cases as follows:

A negro man was admitted to a surgical ward because of a large fluctuating swelling in the right side of the neck. Cervical abscess was diagnosed, and caries of the cervical spine was suspected. He was sent to the Department of Roentgenography for study. On account of pain, swelling, and rigidity of the neck, a true lateral view could not be made. Fortunately, the slightly oblique roentgenogram which was made included the right mastoid process, and we noticed the thickened cortex and the absence of the tip. Suspecting a Bezold mastoid, with cellulitis of the neck, we instructed the technician to make a complete mastoid examination. The Law view shows unquestionably some disease of the right mastoid, and, with the history, one would be inclined to dismiss the case as one showing sclerotic changes due to chronic low-grade infection, which was probably cured. However, in the Arcelin position the eroded process, the absent tip, the condensing osteitis, with central channel and the clear mastoid cells, left no doubt in our minds that this was a typical Bezold mastoid. The mastoid abscess, having perforated the tip of the process, the cells drained into the cellular tissue of the neck, causing the large abscess in that region. This explained the clear mastoid cells and the healthy looking ear drum. A more careful history was obtained from the patient, and it was then ascertained that about five weeks prior to his admission to the hospital he had suffered intense pain in the right ear for four or five days. This pain disappeared as suddenly as it came, leaving some stiffness of the right side of the neck. A few days later he noticed a small swelling just below the mastoid process. The increasing pain, stiffness, and swelling of the right side of his neck compelled him to apply to the hospital for treatment. The patient was transferred from a surgical service to the Otolaryngological Department, a mastoidectomy performed, and the roentgen-ray finding confirmed.

It is Granger's opinion that the petrous bone view (Arcelin) is far superior to the lateral oblique (Law) in diagnostic value, but it is more difficult and tedious to make, and it cannot be made at all with patients who are unruly, very weak, very septic, or who have very short necks, and, because it overcomes these difficulties and limitations, Granger now uses and recommends his own position for making petrous bone views. The Law position has an advantage in that it will give one a very good idea of the distance separating the anterior sinus wall from the posterior wall of the auditory canal.

In our foreign-body work in the lungs, trachea, and esophagus, we must rely almost entirely on radiology for our diagnosis. We must never let a suspected case of foreign body get by without a roentgenograph. Opaque objects are very readily seen and a proficient roentgenologist should have little difficulty in giving us the position, shape, location, and condition of the structures distal to the foreign-body impaction. In cases of non-opaque foreign bodies this is not always so easy, particularly such bodies as peanuts, kernels of corn, beans, watermelon seeds, etc., in the bronchi. Here we have to depend more on the character of the surrounding tissues, and, even then, it is impossible to state definitely that a foreign body is or is not present. Every means at the roentgenologist's command should be used to locate foreign bodies, and, where

the clinical history points to a positive case, he should be exceptionally guarded in his opinion lest a foreign body go undiagnosed. Any change in the lung structure, such as obstructive empyema and atelectasis accompanied by changes in the diaphragm, heart, and shadows of the great vessels, should be regarded as evidence of an obstructive, nonopaque foreign body, blocking the bronchus at some point along its course. Peanuts, beans, etc., usually give the definite characteristic picture of localized pneumonitis.

In cases of long-standing foreign bodies, the report of the radiologist in regard to the lung structure, such as abscess-formation or consolidation, would help the bronchoscopist a great deal in planning his mode of attack on the particular object. On rare occasions the fluoroscope may be of great help, in combination with bronchoscopy, in removing certain foreign bodies, but not many hospitals are equipped for this purpose. Moreover, it is not without its dangers, particularly when inflammable anesthetics are used and the patient and table are not properly insulated.

Some months ago I saw an elderly woman who gave a history of having swallowed a peach-stone and since then had been unable to swallow. Fluoroscopy and a roentgenograph showed nothing, but as soon as a bismuth meal was given and another film taken, the stone showed up perfectly. One negative film in a suspected case should never be considered enough evidence that a foreign body is not present, particularly when non-opaque substances are suspected.

In esophageal work, in addition to foreign bodies, the radiograph is of most valuable assistance in strictures, diverticula, newgrowths, cardiospasm, etc. In any adult over forty to forty-five years of age, in whom we find some esophageal obstruction, which in the X-ray examination shows up as an irregular, nodulated mass, we must always be suspicious of malignancy. In contra-distinction, the smooth, funnel-shaped constriction is always found in benign strictures, cardiospasm, and quite frequently foreign-body stricture. By contrast, diverticula show up as large, rounded-out pouches of the esophageal wall.

Lipiodol injected into the lungs has now become of exceptional value in diagnosing bronchial lesions, and for the first time we have a method comparable with the contrast-medium diagnosis in gastro-intestinal and urinary tract disease. It is now possible to accurately visualize dilated bronchi wherever they are located, and their type and distribution studied. In the presence of dense pleural shadows, we have now a means of certain differentiation between bronchiectasis, empyema with bronchial fistula, multiple abscess formation, and pulmonary tuberculosis.

In conclusion, let me express the hope that, with the cultivation of mutual confidence and habitual thoroughness between the radiologist and otolaryngologist, we may bring forth new and greater aids in the diagnosis of vague and obscure conditions of our specialty, to the end that, by close cooperation, we may become indispensable aids to one another.

REFERENCES

1. Granger, Amedee: New Position for Making Roentgenograms of Mastoids. Jour. Am. Med. Assn., Feb. 5, 1927, LXXXVIII, 372.
2. Granger, Amedee: Roentgenographic Examination of Sphenoid Sinuses. Radiology. January, 1926, VI, 23.
3. Dupuy, Homer: New Method for Measuring Intranasal Distance to Sphenoid Sinus. South. Med. Jour., July, 1927, XX, 536.
4. Looper, Edward A.: Value of Roentgenography to Otolaryngologist. South. Med. Jour., July, 1925, XVIII, 550.
5. Grier, G. W.: Roentgen Diagnosis of Disease in Nasal Accessory Sinuses. Boston Med. and Surg. Jour., July 9, 1925, CXCIII, 50.
6. Hedblom, C. A.: Diagnosis and Treatment of Bronchiectasis. Jour. Am. Med. Assn., Oct. 22, 1927, LXXXIX, 1384.

DUODENAL STASIS[1]

By JAMES A. EVANS, A.B., M.D., La Crosse, Wisc.

THE occurrence of duodenal stasis in all its degrees is rather common in the writer's experience, depending to a great extent on how carefully he looks for it. Records show 41 cases in the past two and one-half years among about 700 studies, or 5.8 per cent.

Clinically the following symptoms are suggestive of duodenal stasis:

1. Chronic dyspepsia, often associated with migraine, as emphasized by the French school, especially Duval (1).

2. A feeling of fullness, often accompanied by nausea, which usually occurs before a meal is finished.

3. Belching and sometimes vomiting soon after eating. The belching is usually prodigious.

4. Epigastric feeling of weight, sometimes amounting to cramping pains; more often immediately after eating; not relieved by soda or food.

5. This distress or pain often yielding to the recumbent position, especially in those cases of stasis due to anomalous bands.

Case (2) cites the pitfalls in the roentgenologic diagnosis, mentioning the frequency with which duodenal stasis occurs in association with pyloric insufficiency and too rapid delivery of barium into the duodenum, and stasis from spinal pressure in the supine position. He states the gauge of stasis to be the promptness of delivery into and evenness of barium distribution in the jejunum. Concerning this latter point the writer is in complete accord with him, making it a custom to carefully study the delivery of barium into the jejunum, the presence of a six-hour gastric residue, and clinically the actual amount of invalidism imposed by the patient's symptoms before suggesting surgery.

The visceroptotic, without any objective cause for his duodenal stasis, has, in Wilkie's hands, received the poorest result from duodenojejunostomy. He found that out of 57 cases operated on, 9 cases reported no improvement, and these 9 included the marked visceroptotics. He further states that the best results are undoubtedly in those cases where prior to operation there was definite roentgenologic evidence of duodenal stasis (3). Indeed, it is only by the most careful study of duodenal function under the screen that the correct operative procedure can be established. The actual functioning of the duodenum cannot be apparent to the surgeon, even with the duodenum before his eyes, as it is to the roentgenologist. An incorrect operative procedure and failure to cure because proper heed was not taken of the actual point of duodenal obstruction is illustrated in the following case.

Case 1. Duodenocholecystic band, compression by mesenteric pedicle. The patient had suffered for fifteen years from epigastric cramps and nausea, suggesting gall-bladder disease. He had obtained no relief on ulcer régime. Physical examination was normal. Gall-bladder visualization showed the gall bladder acutely bent medially. There was a cap defect in juxtaposition to the bent-over gall bladder. There was present also a duodenal stasis above the inferior angle (Fig. 1). At operation a duodenocholecystic band was resected. This measure, however, gave no relief to the patient's symptoms, and it was then realized on re-examination that the patient's symptoms were entirely due to the duodenal stasis in the region of the mesenteric pedicle (Fig. 2). A duodenojejunostomy was refused by

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Fig. 1, Case 1. Barium meal showing cap defect in juxtaposition to bent-over gall bladder. Note stasis and dilatation in second portion of duodenum.

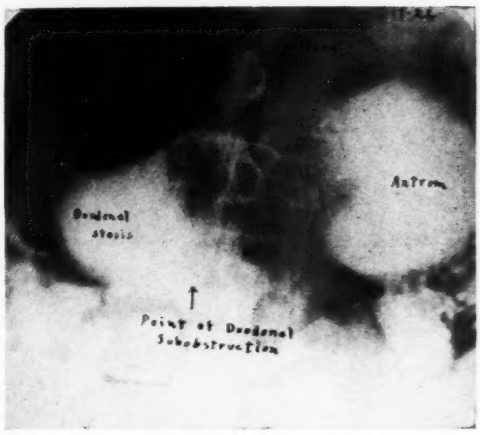

Fig. 2, Case 1. Barium study five months after operation. Same duodenal stasis and dilatation. Small six-hour residue now present.

the patient. A recent letter reports him still suffering from the same symptoms.

The exact cause of a duodenal stasis can be determined to a large extent from a determination, roentgenologically, of the exact location of the sub-obstruction. We wish, therefore, to discuss stasis in the four different portions of the duodenum, following Halpert's excellent study of the duodenal anatomy (4), as shown in Figure 3.

STASIS IN PARS HORIZONTALIS SUPERIOR

Stasis in the first portion of the duodenum is very likely to be more susceptible to accurate pre-operative diagnosis as concerns its cause, than is stasis in the descending or inferior horizontal portions. We have found it associated with more or less gross distortion of the bulb, or a definite narrowing just beyond the bulb, and it is usually quite plain that we are dealing with periduodenal adhesions, and draw upon our clinical history to base our diagnosis of these adhesions as due to duodenal ulcer, gall-bladder disease, or congenital bands. In the case of the very common congenital duodenocholecystic band, cholecystography may aid in the diagnosis, as in Case 1.

Case 2. Duodenal ulcer, periduodenal adhesions. A woman, aged 50, complained of typical duodenal ulcer syndrome, with recent development of severe vomiting and night distress. The physical examination showed a marked ptosis, bulb deformity, and marked tortuosity and deformity of the pars

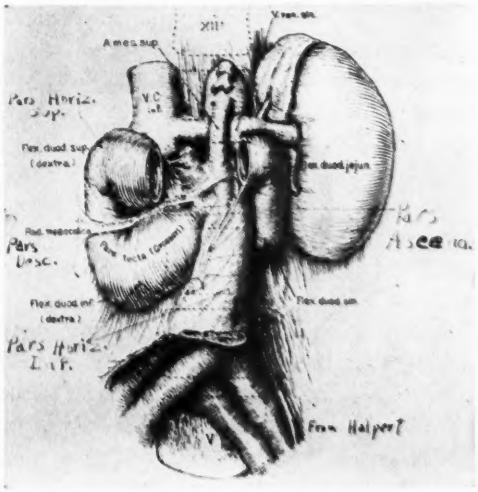

Fig. 3. Duodenal anatomy, after Halpert.

Fig. 4, Case 2. Duodenal ulcer: periduodenal adhesions.

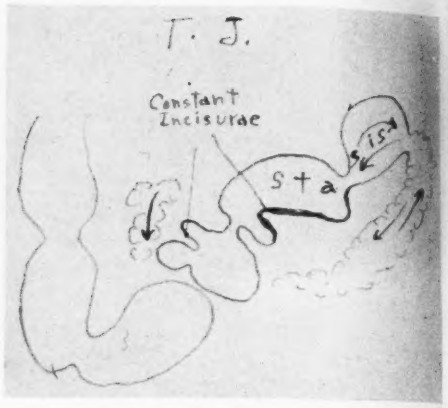

Fig. 5, Case 2. Marked ptosis, bulb deformity, and marked tortuosity and deformity of the pars horizontalis superior.

horizontalis superior (Figs. 4 and 5). Gastric stasis was present. Operation showed a duodenal ulcer with periduodenal adhesions, and gastro-enterostomy was done.

STASIS IN PARS DESCENDENS

Here, too, we have found the sub-obstruction due to periduodenal adhesions as associated with gall-bladder disease or duodenal ulcer, or from a reflex spasm due to duodenal ulcer. From a consideration of Halpert's anatomical diagram we might sometimes find a sub-obstruction in the pars descendens caused by mesocolic artery compression, as it courses in the radix mesocolica to the ascending colon. In our experience, however, such a compression occurs at the inferior angle in the pars horizontalis inferior and is very difficult to distinguish roentgenologically from that due to pressure by the mesenteric pedicle. However, a point of stasis at the very bottom of the descending portion, associated with a ptotic cecum, would strongly suggest that the surgeon carefully investigate the middle colic artery. Such a case requires a colopexy in the opinions of the Kelloggs (5) and Bloodgood (6), and often a duodenojejunostomy as well, if surgery must be resorted to.

Case 3. This patient suffered from a typical ulcer syndrome of one year's duration until one month before examination. At this time she began to experience a very severe cramping pain immediately after eating, often accompanied by vomiting and also by prodigious belching. Fluoroscopic examination showed a marked constriction at the top of the cap and a stasis in the upper portion of the pars descendens (Fig. 6). At operation a duodenal ulcer was found in the bulb, and beyond the ulcer a dilatation of the beginning of the pars descendens, evidently due to a spasm. There were no periduodenal adhesions and no evidence of middle colic or mesenteric pedicle compression. A gastro-enterostomy was performed.

STASIS IN PARS HORIZONTALIS INFERIOR

To us, the greatest number of patients with stasis near the inferior angle seem to fall in the functional group: (1) Viscer-optotics, the stasis perhaps being due to arteriomesenteric compression (very hard to

Fig. 6, Case 3. Marked constriction at the top of the cap and a stasis in the upper portion of the pars descendens.

Fig. 7, Case 4. Stasis in the pars horizontalis inferior, with marked antiperistalsis in the descending portion, and moderate dilatation. Mesenteric pedicle compression.

prove pre-operatively), or (2) cases due to reflex causes.

Now the fluoroscopic picture of this reflex stasis and that due to arteriomesenteric compression are exactly similar, the point of sub-obstruction occurring in the pars horizontalis inferior in both cases. Here the greatest difficulty in diagnosis arises—Is there an actual mechanical obstruction due to arteriomesenteric compression, demanding duodenojejunostomy perhaps, or a functional stasis of reflex origin, or both?

The reason why reflex antiperistalsis is so often seen in the descending portion of the duodenum, above the stasis in the pars horizontalis, becomes evident in the light of the following studies on peristaltic and antiperistaltic movement in the duodenum. Borcesco, Béclère, and Porcher in a recent article (7) have described minutely the movements of the duodenum which they studied by instillations of barium through the duodenal tube, by serial radiographs, and the screen. They state: "Antiperistaltic movements always exist normally in the second portion of the duodenum, very rarely in the bulb, and are very little developed, if not entirely absent, in the last portion of the duodenum. Antiperistaltic movements at the level of the second portion exist normally, are more developed in its middle portion, and become less the farther one progresses upward from the inferior angle. Pathological antiperistaltic movements, which are only normal movements greatly exaggerated, are continuously visible in the fluoroscope and are always accompanied by dilatation of the organ."

The following case illustrates the difficulty in differentiating a reflex stasis from a mechanical stasis in this region.

Case 4. A young man of 25 years complained of a full feeling immediately after taking food, which had prevented him from eating a full meal for the previous three months. This feeling was accompanied by bloating, belching, and regurgitation of food. On vomiting he would obtain immediate relief. Eating immediately produced an epigastric cramp. Fluoroscopic studies showed stasis in the pars horizontalis inferior, with marked antiperistalsis and moderate dilatation in the descending portion (Fig. 7). At operation a fibrosed appendix and a slightly thickened, "strawberry" gall bladder were removed. The operation gave

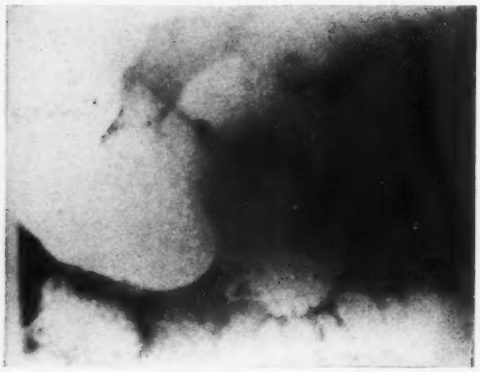

Fig. 8, Case 5. Gall-bladder disease, with stasis.

Fig. 9, Case 5. "A roentgenogram of the gall-bladder area revealed shadows of gallstones."

no relief, and the patient returned in one month, still complaining of the same "fullness" after the first few mouthfuls of food. Dietary measures, exercise, and abdominal support now relieved the patient to a great degree and permitted him to gain fourteen pounds in weight. The operating surgeon in this case could not convince himself that a duodenal stasis was present.

We would like to suggest that duodenal stasis has been such a common finding in this functional group, under which we include the mesocolic or arteriomesenteric compression of the visceroptotic, and the reflex stasis of gall-bladder disease, etc., that we have become wont to ascribe to this stasis the mechanism by which is produced most of the symptoms.

Reflex stasis due to disease elsewhere in the abdomen occurs in the following order of importance: (1) gall-bladder disease; (2) duodenal ulcer; (3) chronic appendicitis; (4) irritable colon. Bloom and Arens (8) state that 66 per cent of their cases that came to operation had gall-bladder disease, and that chronic ileus due to mechanical obstruction is rare.

Probably, when we ascribe this condition to a reflex, we would be speaking more accurately if we called it due to duodenitis. Rehfuss (9) makes it a point to study the duodenal cytology obtained by intubation, and this we have done in some of our cases. The complete Lyon's test may throw further light on the duodenum in case of biliary tract infection.

Case 5. This is a case of gallstones and duodenal stasis in the pars horizontalis inferior. Since the age of 6 years, the patient had suffered from attacks once a year of violent cramp-like pain in the epigastrium, suggesting gall-bladder colics. Barium studies were normal except for slight stasis in the pars horizontalis inferior and reflex antiperistalsis in the pars descendens, considered to be reflex to gall-bladder disease (Fig. 8). A roentgenogram of the gall-bladder area revealed shadows of gallstones (Fig. 9). The surgeon removed a diseased gall bladder containing several faceted gallstones.

At operation an obstruction can be demonstrated by McKenty's (10) maneuver—he

Fig. 10, Case 6. Duodenojejunal flexure kink, showing stenosis and dilatation in second portion of duodenum.

Fig. 11, Case 6. Same case as shown in Figure 10. Showing wave of antiperistalsis, revealing cap.

places his finger behind the superior mesenteric artery, or the middle colic artery, as the case may be, and observes the effect of elevating and depressing the small intestines in the first case, the cecum in the latter. Cancer in the head of the pancreas or mesenteric glands may also cause compression and obstruction in the pars horizontalis inferior. A rare duodenal cancer may cause obstruction in any portion.

STASIS IN PARS ASCENDENS

When a stasis occurs in the pars ascendens, we have found the point of obstruction to be at the duodenojejunal flexure, and the cause is more safely considered mechanical. The point of duodenal irritability and antiperistalsis has been passed, making reflex stasis here impossible. The obstruction is then due to a kink or compression at the duodenojejunal flexure, caused by an overdeveloped ligament of Treitz, or an abdominal band in this region, as illustrated by the following cases.

Case 6. This is a case of obstruction at the duodenojejunal flexure due to kink and band. A young man 19 years of age complained of epigastric pain, with vomiting, occurring four or five minutes after eating, night distress, and hematemesis. No relief was obtained on ulcer régime. Under the screen the barium could be seen to reach the pars ascendens, when it would be suddenly and violently thrown backward by a powerful antiperistaltic wave. Marked dilatation of the entire duodenum (Figs. 10 and 11) was present. At operation the first inch of the jejunum was found to be held upward and to the right by a band, producing an acute kink at the duodenojejunal flexure.

Case 7. This is a case of stasis in the pars ascendens, probably due to duodenojejunal kink, not operated upon. A young man 18 years of age complained of a feeling of "fullness" before he finished his meal, whereupon he would immediately rise from the table to vomit almost all he had eaten. He complained of constant hunger. He had lost twelve pounds in weight in one month, and complained of constant headache. The barium could be seen to reach the duodenojejunal flexure. The pars horizontalis inferior and pars ascendens were markedly dilated. Reflex peristalsis was very active (Fig. 12).

Fig. 12, Case 7. Duodenojejunal flexure kink. The examiner's gloved finger, pressing the antrum upward, reveals the point of obstruction near the finger's tip.

CONCLUSIONS

1. Great conservatism is urged in advising surgery for incidental findings of duodenal stasis. Study carefully the passage of barium into the jejunum and be guided by the presence of an accompanying gastric stasis.

2. Fluoroscopic study gives a better idea of duodenal function and stasis than the surgeon can obtain at operation, especially in the case of mesenteric pedicle or middle colic artery compression.

3. It is desired to lay special stress on duodenal stasis in the pars horizontalis inferior and the accompanying antiperistalsis in the pars descendens as a reflex phenomenon due to gall-bladder disease, duodenal ulcer, and possibly an irritable appendix or an irritable colon.

4. The roentgenologic differentiation between compression by the middle colic artery and compression by the superior mesenteric artery is difficult, although the point of obstruction being present at the lowest portions of the pars descendens and associated with a mobile cecum strongly suggests the former.

5. The diagnosis of the cause of stasis in the pars horizontalis superior and pars ascendens is not subject to so great an error.

REFERENCES

(1) Duval, P., and Roux, J. C.: Les Migraines Duodénales. Arch. des Mal. de l'App. Dig., January, 1924, XIV, 74.

(2) Case, James T.: Chronic Obstruction of the Small Intestine. Radiology, July, 1927, IX, 1.

(3) Wilkie, D. P. D.: Chronic Duodenal Ileus. Am. Jour. Med. Sci., May, 1927, CLXXIII, 643.

(4) Halpert, Bela: Arteromesenteric Occlusion of the Duodenum. Johns Hopkins Hosp. Bull., June, 1926, XXXVIII, 409.

(5) Kellogg, E. L., and Kellogg, W. A.: Chronic Duodenal Stasis. Radiology, July, 1927, IX, 23.

(6) Bloodgood, J. C.: Dilatation of the Duodenum in Relation to Surgery of the Stomach and Colon. Jour. Am. Med. Assn., July 13, 1912, LIX, 117.

(7) Borcesco, A., Beclere, H., and Porcher, P.: Les Mouvements du Duodénum. Arch. des Mal. de l'App. Dig., June, 1927, XVII, 630.

(8) Bloom, A. R., and Arens, R. A.: Duodenal Stasis. Jour. Am. Med. Assn., Oct. 15, 1927, LXXXIX, 1330.

(9) Rehfuss, M. E.: Organic Duodenal Pathology. Med. Clin. N. Am., September, 1926, X, 2, p. 441.

(10) McKenty, J.: Surg., Gynec. and Obst., April, 1924, XXXVIII, 444.

A very complete bibliography of the literature prior to November, 1926, on duodenal stasis appears with the paper, cited above, by E. L. and W. A. Kellogg (5).

DISCUSSION

Dr. James T. Case (Battle Creek, Mich.): Dr. Evans' paper is very carefully written and deserves our deliberate consideration. I would not be hasty to accept his criticism regarding the advice of surgical interference for incidental findings of duodenal stasis. Many of these cases may be helped by surgery.

RADIOLOGY AS A MEDICAL SPECIALTY[1]

ITS DEVELOPMENT, WITH ESPECIAL REFERENCE TO THE RELATIONS BETWEEN HOSPITALS AND RADIOLOGISTS[2]

By W. EDWARD CHAMBERLAIN, M.D., San Francisco
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THE Council on Medical Education and Hospitals is investigating departments of radiology and radiologic laboratories because many such departments and laboratories are improperly conducted and unworthy of a place in modern medical practice. Such an investigation is quite properly assigned to the Council, and much good can result from this study.

Radiology is a kind of medical practice, and not simply a group of technical procedures. This is the main issue. The danger lies in the fact that this point is not generally recognized. What is it that enables laymen to operate roentgen-ray laboratories? The support of a part of the medical profession, of course. Why do physicians send patients to such lay laboratories? Presumably because they believe that radiology is simply a group of technical procedures, to be carried out by any one with proper apparatus and floor space.

My proposition is that if "apparatus," "housing," or "capacity to carry out this or that technical detail" is made a part of the "Essentials for Approval," then this emphasis on purely technical details will cloud the issue, call attention to non-essentials, and postpone the day when radiology shall become generally recognized for what it really is. But if the attitude is taken that the roentgen examination is fundamentally a kind of medical consultation and that the one "essential" is that the laboratory or department be in full charge of a qualified radiologist, then at once the foundation is laid for a solid future.

As a radiologist, I would like to see all roentgen-ray departments properly housed, well ventilated, and nicely decorated. I detest bad air and basement light. But I prefer a lot of "old junk" in the basement, in full charge of a competent radiologist, to a beautifully appointed and spacious department where the control rests with the hospital superintendent, and where a radiologist, untrained and inexperienced, is selected because he can be hired for less than half of what it would cost to obtain the services of a qualified man.

Let us suppose, for a moment, that it is required that every approved laboratory or department be in full charge of a properly qualified medical specialist, and that all details of technic and equipment have been left to that specialist by requiring from him, before approval of the department, a statement that his equipment and personnel are such as to enable him to do good work. What more can be done for the situation? Let us briefly survey the problem:

1. Laymen still operate roentgen-ray laboratories in many parts of the country, and are enabled to continue because they are actively supported by physicians. This problem of the lay laboratory in radiology has been attacked in many ways, but never yet in the right way, which is within the medical profession itself. The favorite method of attack has always been to go to the state legislature and ask for a law. This favorite American "cure-all" may work in some states; in fact, I am told that the lay

[1]Reprinted by permission from the *Journal of the American Medical Association*, March 30, 1929, XCII, 1033.

[2]Read before the Annual Congress on Medical Education, Medical Licensure and Hospitals, Chicago, Feb. 20, 1929.

laboratory has been legislated out of existence in New York State. But usually the law fails of passage, or is vitiated in passage, because the legislator discovers, as soon as he investigates, that the laboratories which he is being asked to throttle would long since have died a natural death but for the support of a goodly percentage of the very group that is asking for the legislation. Some years ago one of these laws was proposed in the California legislature, and one of the laymen who would have been affected by the law produced a petition signed by seventy-one physicians of San Francisco. This petition expressed confidence in the ethical character of the layman's work, and asked that no legislation be passed which might injure the business of said layman. Almost every one of these seventy-one physicians was a member of the American Medical Association, and a number were very prominent in their community.

The fact is that laymen could not continue to operate roentgen-ray laboratories if the medical profession stopped sending them patients. I have been able to discover only two reasons for this support of lay laboratories by physicians. The first is a failure on the part of physicians to appreciate the value of consultations with radiologists. Some physicians believe that when it comes to interpreting roentgenograms, one man is as good as another. The cure for this is to bring such unenlightened physicians into contact with qualified radiologists. They will discover that the help they receive from such contacts is indispensable both to themselves and to their patients. The second cause for the support of lay laboratories by physicians is not so easy to cope with, for it is based on a fundamental frailty of human nature. There are a good many physicians who will not call on a fellow physician for consultation if they can possibly avoid it. Such men instinctively feel that to refer a patient to another physician for a radiologic service or any other service is to admit a sort of incapacity in themselves. On the other hand, they will refer the case to a layman because the patient can be made to feel that it is only a picture which the layman is producing and that the matter of diagnosis rests entirely with the referring physician.

2. There are not enough radiologists. One reason for this is that young physicians are reluctant to prepare themselves for a field in which some of the leaders are little more than glorified technicians. How often does the internist or surgeon refer a case to the radiologist as a diagnostic or therapeutic problem, without any strings attached? The answer is, very seldom. As a rule the patient referred for therapy has been told how he may expect to be treated, and the one referred for diagnosis is not infrequently sent with detailed instructions as to what films are to be exposed, instead of with a request for an opinion regarding certain organs or disease processes.

Medical students have frequently told me that they were at first attracted by radiology because of its scientific appeal and broad applications, but later became discouraged with it as a life work. With some this discouragement has arisen from first becoming convinced that radiology can best be practised in a full-time hospital capacity, and then discovering that such a full-time arrangement generally entails allowing the hospital to carry on the practice while the radiologist works for a salary. This tendency to put the hospital radiologist on a flat salary basis has been growing of late. It is a direct outcome of the discovery by hospital managements that there is money to be made from the practice of radiology by the hospital provided a sufficiently low-priced radiologist can be hired. Profits could also be made to accrue to the hospital from the practice of surgery, but in private practice the patient insists on selecting his own sur-

geon, and surgeons cannot be exploited by hospitals because they occupy a much more independent position in the scheme of things. Surgeons can seldom be persuaded to accept a salary and allow the hospital to collect their surgical fees. There are a few exceptions, where the salaries are large.

Why, then, can hospitals hire radiologists at salaries that enable the hospitals to gather in profits which they do not earn? Because neither patient nor clinician is very particular as to who does his radiology. This takes us back to the fundamental misconception, indulged in by many physicians and nearly all patients, that radiology is not a kind of consulting medical practice but a group of technical procedures, to be carried out by any one with the necessary apparatus and technic. It cannot be expected that any considerable number of young medical graduates will turn to radiology in preference to general medicine or surgery until radiology is more generally recognized as a type of consulting medical practice.

3. The system of charges for service by radiologists is fundamentally wrong. It bears too much resemblance to the schedule of charges of a photographic studio, and scarcely any resemblance to the schedule of charges of any of the other medical or surgical consultants. Especially is this true where industrial accident commissions or other governmental agencies have undertaken to set up fee schedules, the emphasis having been placed on the number of films and the size of films, as though the radiologist were a merchant selling celluloid by the square inch. One immediate result of this failure to recognize the consultation element in the work of the radiologist has been to deprive the patient of the benefits of such a consultation by encouraging the making of roentgen examinations in lay laboratories or in the industrial accident surgeon's own office. In either case, the examination is paid for at the same rate as when made by a radiologist with consultation service included.

In California, the present industrial accident fee schedule is sufficiently high to bring the radiologist a fair consultation fee, over and above the cost of his technical procedures. But the employers and industrial accident commission are trying to reduce the fee schedule because they realize that they are paying too much for "celluloid" where no consultation service is involved. The obvious remedy is a fee schedule in which the radiologist's consultation service is recognized and is paid for when, and only when, it is rendered.

4. Relations between hospitals and radiologists can be immeasurably improved, to the advantage of both parties, and, what is more important, to the advantage of patients and referring physicians.

Many hospitals with sufficient work to warrant the employment of a full-time radiologist are content with inadequate service, such as occasional visits from men whose primary interests are centered in their downtown offices. In such hospitals the technical part of radiology may be at the service of the hospital staff all day long, but the radiologist is there for so short a time that the hospital staff never forms the habit of frequent consultation with him. This is a loss to the radiologist, too, for he is practising his specialty imperfectly.

I have been called on a good many times to try to help a hospital and a radiologist arrive at a fair working agreement. It has been my experience that hospital managements put financial return ahead of professional success, and drive away the best radiologists by insisting on retaining the actual control of the department. That there is a fundamental difference in the point of view between the radiologist and the hospital management cannot be denied. It shows itself in many ways. The hospital management has an interest in rigid economy of

floor space, pay roll, and expenditures for supplies and apparatus. The radiologist, on the other hand, cannot advance himself or his specialty unless funds are constantly available for modernizing the equipment and expanding his department as its importance increases.

The remedy is again rather obvious. The business arrangement between hospital and radiologist should be such that the radiologist has an interest in economy comparable to that which he would have in his own laboratory, with a corresponding right to order expenditures. No one worries lest the radiologist spend too much on the supplies, apparatus, and floor space at his private office. It is obvious that when he replaces an obsolete piece of equipment with a new one the expenditure is necessary or at least thoroughly justifiable. Yet I have known the most necessary apparatus purchase for a hospital department to be denied, apparently because the salaried radiologist was not believed to have a proper regard for the funds of the hospital.

In arriving at a proper business arrangement between the radiologist and the hospital, the following facts must be borne in mind: The hospital is entitled to a fair return on its investment in space and equipment, with a liberal allowance for obsolescence, which is notoriously a big item in X-ray apparatus. Beyond that, in special cases, there may be grounds for a percentage of the net proceeds going to the hospital. But when it is appreciated that every fee collected is in large part a fee for the radiologist's services as a consultant, it is at once apparent that the business arrangements which now obtain between many hospitals and their radiologists amount to nothing more nor less than exploitation of those radiologists.

That radiology is being held back by the inadequate solution of some or all of these problems is proved by a comparison of the volumes of radiologic practice per hospital patient in different institutions. There is four or five times as much work in the enlightened institution with a qualified radiologic consultant as in the hospital in which only the technical side of radiology has been developed, or in which the radiologist is available for consultation for only a small part of the time.

By this time some one is asking: "What can the Council on Medical Education and Hospitals do about these multifarious problems?" It is not at all certain what can be accomplished right now, but one is perhaps justified in supposing that the mere exposure of some of these problems to the light of day will aid in their solution.

Some of my confrères are perturbed because the A B C Hospital roentgen department does diagnostic roentgenology without roentgen and radium therapy, or because the ultra-violet ray equipment at the X Y Z Hospital is in the physical therapy department instead of in the department of radiology, or because of some similar limitation in the scope of this or that department. To many of us such things are non-essentials and are not to be compared with such important matters as the exploitation of radiologists and other laboratory specialists by hospitals, and the tendency for the purely technical side of laboratory procedure to overdevelop at the expense of the precious consultation element.

SUMMARY

1. The problem of lay laboratories will not disappear until the medical profession recognizes that radiology is truly a branch of medicine, and that it is fundamentally wrong to send patients to lay laboratories.

2. There will not be a satisfactory influx of young medical graduates into radiology, nor a satisfactory development of radiology in the hospitals, until the relations between hospitals and radiologists have been im-

proved. The hospital radiologist must be offered an opportunity for self-development comparable with that of his brothers in medicine and surgery.

3. Under the present scheme of things there are many instances of the exploitation of radiologists by hospitals. The amassing of profits by the hospital from the radiologist's services constitutes exploitation whenever such profits exceed what can be justified by the material outlay and investment in apparatus and space.

4. There is need for a revision in the fee schedules for radiologic services, because most of those now in operation place the radiologist in the position of selling celluloid by the square inch instead of rendering a type of medical consultation service.

THE STATUS OF RADIOLOGY IN AMERICA[1]

By ARTHUR U. DESJARDINS, M.D., ROCHESTER, MINN.

IN December, 1895, Röntgen announced to the world his epoch-making discovery of what, for want of a better name, he chose to call "X-rays." This announcement produced a sensation not only in scientific circles but also in the medical profession and even among laymen. So immediate and profound was the effect of this discovery that, within a few weeks, scientists and physicians in different countries were producing X-rays to acquaint themselves with them and to test their unique properties. Many physicians journeyed to Europe to study the potentialities of the new rays and returned to communicate their amazement and enthusiasm to their fellow practitioners. Among these a number of pioneers, convinced that roentgen rays would rapidly open a new chapter in medical practice, proceeded to equip themselves with the apparatus required to generate the rays, to familiarize themselves with the technic of their application, and to study the possible range of their usefulness in medicine. As might have been expected, those who possessed special knowledge in electricity, engineering, and photography progressed more than their fellows who had not had such advantages, and it was not long before the more advanced disciples of the budding science of roentgenology began to forsake the general practice of medicine to devote their energies and their time to this virgin field.

Before the scientific and medical worlds could recover from the revelation of Röntgen, they were startled anew by the announcement, through Becquerel and the Curies, of the no less revolutionary discovery of radium. This was the signal for another pilgrimage across the ocean to the new shrine of knowledge, and many of these pilgrims exchanged their tribute for some of the precious substance which held forth such promise to science and to suffering humanity. This second pilgrimage was much smaller than the first only a few months before, because radium, as produced at that time, was so costly that only a few institutions and well-to-do individuals could afford to purchase it. In general, therefore, the two bodies of pilgrims were separate and distinct, and for the same reason the disciples of Becquerel and Curie did not increase in number so rapidly as those of Röntgen. It is important to bear in mind these circumstances, which explain much of what has since occurred in the field of radiology.

The rapid development of roentgenology and its daily increasing application to almost every phase of medicine are well known to every one. At first regarded as important only for its usefulness in diagnosis, it was soon revealed as no less useful in the treatment of many ills, in some of which it has become recognized as the therapeutic method of choice. Among the pioneer roentgenologists some were so intent on their studies of this fascinating new method that they heard of the discovery of radium as of a storm in a distant country. Others instantly recognized the import of this discovery, but did not have the means to avail themselves of its possibilities and to broaden the scope of their activities. As time went on, it became possible for some of them to acquire radium and thus to give birth to the specialty of radiology as distinguished from the more limited field of roentgenology. Looking back on these his-

[1] From the Section on Radium and Roentgen-ray Therapy, The Mayo Clinic. Read before the Annual Congress on Medical Education, Medical Licensure and Hospitals, Chicago, Feb. 20, 1929. Reprinted by permission from the *Journal of the American Medical Association*, March 30, 1929, XCII, 1035.

torical antecedents it now appears singular that many of the physicians who took up roentgenology as a life work should have confined their interest to the diagnostic phase of the subject. The reason probably was that diagnostic roentgenology appeared to have broader relations to other branches of medicine than therapeutic roentgenology, and, hence, its practice seemed more remunerative. This, of course, was a narrow and unsound view, but it is one still held by many who are not thoroughly familiar with the therapeutic aspects of the subject.

As a result of these several factors, medical radiology has grown up as a distorted and ungainly infant. Instead of a general well rounded development, its growth has been featured by lack of intelligent supervision and care and by unfortunate divisions of parental responsibility. Let us hope that it may still be time to take this abnormal child in hand, correct its deficiencies and bad habits, and make of it a lusty, well rounded adult in the family of medical sciences.

If we cast a glance at the radiologic situation in America as it exists to-day, what do we observe? We see some physicians devoting their time exclusively to diagnostic roentgenology, some to both diagnostic and therapeutic roentgenology, some to radium therapy, some to therapeutic radiology, while only a minority have become proficient in, and practise, general radiology. This state of affairs in private practice is reflected in a corresponding lack of sound organization even in the best hospitals, clinics and other institutions for the care of the sick. One hospital may have an excellent department of diagnostic roentgenology but may not have any facilities for and not give any attention to therapeutic radiology. Another institution may be equipped and staffed to carry on all the activities of radiology, but each phase of the subject may be dealt with in separate departments under separate and independent directors. The first impression of such an arrangement may be that it enables the institution to utilize the services of an expert in each branch of the subject, but closer examination and prolonged experience reveal the weaknesses of the scheme, weaknesses inherent in lack of unity and leading to differences of opinion in respect of relative importance or precedence, of administrative influence, of teaching, of the actual technic of diagnosis and treatment, and of the harmonious growth and development which these various weaknesses tend to prevent. The inevitable consequence is that, with the exception of a small number of exceptionally qualified experts, the general level of the specialty is not high, and workers in this field may often be heard to bewail the faint respect with which their efforts are viewed by their fellow physicians in other specialties. It is unfortunate that radiologists cannot hear more often the comments made by able internists and surgeons concerning radiologic practice. For example, a prominent internist in one of our large cities wrote me recently that, even among the best roentgenologists, the variation in the ability to interpret roentgenograms was astonishing and that he knew a few internists and surgeons whose interpretative ability was often superior to that of his roentgenologic colleagues. This is leading an increasing number of internists and surgeons to acquire the smattering of knowledge which they consider sufficient to enable them to carry out for themselves the radiologic procedures involved in the care of their patients. It is folly for the radiologist to attempt to tell such medical or surgical confrères that they are making a mistake. The only effective way of stopping this tendency and of preventing such an error is to raise the level of radiology and the ability of the average radiologist.

The effect of the general attitude of the profession is shown further by the common

practice of hospitals and private physicians of employing not a professional specialist in radiology but a non-professional technician, who often is expected only to make roentgenograms, the interpretation of which is reserved to the professional employer or to the members of the hospital staff, but whose opinion is sometimes accepted and acted on by the physicians who employ him. It is obvious that physicians working under such conditions cannot realize, or give their patients advantage of, the full possibilities of medical radiology. In some instances this practice is due to financial inability to employ a qualified radiologist; sometimes it springs from a basic ignorance of the possibilities of high-grade radiology; sometimes from the impecunious or niggardly policy of the hospital authorities, who are not averse to using the radiologic service of the institution as a fertile source of revenue; or it may be the natural and inevitable result of the limited supply of qualified radiologists. Whatever the reason, the chief sufferer is the patient, who does not receive the grade of professional service to which he is entitled; but the medical profession also suffers, because any error in diagnosis or deficiency in treatment is a reflection on the entire medical body.

Another factor in this tendency has been the gradual simplification of construction and manipulation of the apparatus required to generate roentgen rays. The trend of development in the technic of roentgenography has been marked chiefly by the constant endeavor of manufacturers to produce generators the operation of which would be so simple that an increasing number of physicians would be impelled to purchase them, regardless of their lack of that extensive body of special medical and physical knowledge necessary to take full and intelligent advantage of the possibilities of roentgenology. The medical profession, unfortunately, is still suffering from the childish but natural delusion that roentgenography differs very little from photography. We constantly hear the expression "X-ray picture" used by internists, surgeons and even by certain roentgenologists, who thereby show their limited conception of roentgenology. This trend toward simplified construction, ease of manipulation, and standardization of technical procedures, accompanied by a tremendous extension of the credit system in commercial transactions, a corresponding expansion of advertising, and the development of high-pressure salesmanship as a means of increasing the volume of sales, has had much to do with the wide dissemination of roentgen-ray apparatus not only in legitimate medical circles but also among the quacks and outlaws of the borderland. So far as legitimate medicine is concerned, many practitioners using radiologic procedures in diagnosis and treatment are not qualified for such work, and this tends to lower still further the level of radiology.

A deplorable result of the present situation is that, with some exceptions, so few young physicians of real caliber are willing to enter the field of radiology as a life work. Most of them feel that they do not care to take up diagnostic roentgenology only, therapeutic roentgenology only, or radium therapy. Such split-off fragments of the atom radiology are too narrow fields for a really intelligent and ambitious physician. It would be surprising indeed if, under present conditions, things should be different in this respect. This is perhaps the most serious defect which American radiology must overcome.

The word "radiology" implies that branch of science the medical phase of which deals with the diagnostic and therapeutic application of radiant energy, including roentgen rays, radium, ultra-violet rays, and other spectral radiations. To limit the expression "medical radiology" to roentgen

rays and radium, therefore, is not consistent with the etymology of the word "radiology." In England, partly as a result of war psychology and partly for the sake of euphony, "radiology" and its derivatives are generally employed when "roentgenology" is intended. Thus, British radiologists speak of "radiography" instead of "roentgenography," "radioscopy" instead of "roentgenoscopy," and "radiogram" instead of "roentgenogram." The same is true in France, Italy, and Spain, except that, in these countries, the main reason is one of euphony; the prefix "roentgen" was seldom used, even before the war.

If this definition can be accepted as sound, the medical application of ultra-violet rays and other spectral radiation falls within the scope of medical radiology. In connection with ultra-violet rays a curious situation has developed. For various reasons the rapid expansion of ultra-violet therapy has left the radiologist cold and, at least in institutions, this valuable method of treating certain diseases has been relegated to the realm of physical therapy. The result has been that, in most of the best hospitals, ultra-violet irradiation is given by non-professional technicians, without the supervision of a physician expert in such matters. Now there is no doubt that the radiologist's special knowledge of radiations generally makes the department of radiology of a hospital specially qualified to assume the responsibility for such work. Also there is no doubt that such expert medical supervision should favor the sound development of this phase of medicine. If, from the start, ultra-violet therapy had been more generally confined to the radiologist, there would probably now be much less of the hocus-pocus that has come to be associated with this kind of treatment. The private radiologist, of course, must remain free to include or to exclude ultra-violet therapy as he may see fit, because the conditions that surround the work of each specialist vary to such a degree that no general measure can be framed that will apply to all, without injustice. The most that can be done is to recommend that private radiologists should interest themselves in this aspect of radiology.

Strictly speaking, infra-red rays also constitute a phase of radiology, but their therapeutic usefulness is so closely related to modes of physical therapy, such as massage, corrective exercise, mechanotherapy, and electrotherapy, that it would hardly be feasible or advisable to separate them by placing infra-red rays in the department of radiology, unless, as in certain institutions, the departments of radiology and physical therapy should be one and the same or should be in close proximity. But since these factors do not affect ultra-violet irradiation, this could and should consistently be made a part of general radiology.

Some of the foregoing conditions and tendencies are not confined to America but affect the medical profession of different countries to varying degrees. The radiologists of Great Britain, for instance, have for some time been concerned over certain phases of the situation. As an example I need only quote Dr. L. A. Rowden, president of the Section of Radiology of the British Medical Association, who, at the meeting of the association at Glasgow in 1922, said, "I fear for the future of radiology. . . . There is a tendency for us to be forced into the position of mere technicians." To which Dr. A. E. Barclay, of Manchester, pertinently replied that the man without a knowledge of clinical medicine could not get anywhere, but that the man who knew his clinical medicine and his radiology as well had nothing to fear, and would make his way wherever he went in any company of surgeons and physicians. British radiologists have wisely attempted to correct many of the present deficiencies of radiology as related to medical practice

by bringing about a fusion of the several bodies into which they were divided, with the object of raising the standard of radiologic practice and removing the many obstacles that have obstructed its progress. The situation in Germany closely resembles that of America, and for much the same reasons. The conditions in France are distinctly more favorable, and this is precisely because, in that country, the unfavorable factors which I have described have not been allowed to develop to anything like the same degree.

Several factors have conspired to produce the existing conditions: (1) the circumstances that have surrounded the development of medical radiology and the failure to organize its various phases along sound lines; (2) the lack of thorough fundamental training in radiology, and (3) the unfortunate loss of contact with clinical medicine by which many radiologists are handicapped.

The first reason has already been set forth. In connection with the second reason, there are only one or two schools in this country in which anything approaching a thorough course of instruction in radiology is given. Compare this with the courses available in England, France, and Sweden, where the courses in medical radiology are superior to anything of the kind given in this country. With reference to the third reason, too many American roentgenologists and radiologists have allowed themselves to lose contact with clinical medicine to such an extent that they actually live in a world of shadows. There can be no doubt that the greater the knowledge of the radiologist in anatomy, physiology, pathology and general clinical medicine, the better radiologist he will be and the more will he be able to command the respect of his medical and surgical colleagues. Too many, unfortunately, have become what might be called supertechnicians and are hardly physicians at all.

Another important consideration is that in most European countries a physician may not pose as a specialist unless he has adequate special training and experience in his specialty. In striking contrast is the facility with which, in America, any physician may set himself up as a specialist after a six weeks' course at some post-graduate school. That this glaring defect of American medicine is being recognized is shown by the effort of certain groups of specialists, such as the surgeons, ophthalmologists, and otolaryngologists, to clean house and establish standards for the protection of the public and of the profession itself. It is only a matter of time before the different state or federal governments will require that a physician desiring to be recognized as a specialist shall pass a separate examination before a board of well known specialists in each branch of medicine. For the present, however, each professional group must proceed to do its own house-cleaning or lose the esteem and respect of other groups.

American radiologists and roentgenologists have allowed a situation to develop which is undesirable from many points of view, because if permitted to go on it may easily lead to the disappearance of the specialty as such or at least may prevent it from reaching that development which it should logically attain. In the older countries of Europe, professional men in general are less inclined to allow themselves to be pushed by events; they try to foresee events and conditions and to map out sound lines for the development of their respective professions. In America, which is much younger and of extremely rapid growth, it is perhaps not surprising that there has been a tendency to allow things to grow helter-skelter, without much attempt to formulate plans so that growth would be more orderly and lead to a better product. A parallel

is to be found in the highway situation. During the earlier years, the scattered and scanty population of many of our states made it impossible for really first-class highways to be constructed. In most parts of the country, indeed, there would have been no need for such perfect highways, even if the men and money had been available to construct them. Later, however, with the advent of the automobile and the rapid growth in population, good roads became absolutely essential. As a result we find every state in the Union spending enormous sums to reconstruct its highways and to shorten them as much as possible; that is, to make them as nearly as possible a straight line between two points. During the early days of radiology its growth was dependent on the activities of a few pioneers to whom we owe a great deal. Now, however, the time has come to "straighten our highways" and not only to build them right but to remove as many of the kinks and curves as possible.

In attempting to improve the present situation, the first and most important step, it seems to me, must be to take measures to attract to the field of radiology young physicians of the highest caliber. It is obvious that the quality of the work rests not so much on apparatus and machines as, primarily, on the intelligence, ability, and training of physicians. The better the workman, the better the product. The first step, therefore, to make radiology more attractive to able and ambitious young physicians is to remove those artificial divisions which have been acting as inhibitory influences. A career in radiology must be made as interesting and satisfying from every point of view as a career in any other phase of medicine. Medical institutions generally should gradually be impelled to reorganize their separate services of diagnostic roentgenology and therapeutic radiology into departments of general radiology under competent directors. This naturally cannot be done at once, because a sufficient number of competent directors cannot be found; but this should be the goal toward which every effort should be directed. The supply of well trained general radiologists can be increased only by improving the quality of instruction in this subject. Undergraduate courses in medical radiology must necessarily be limited to a bare outline of fundamental principles. As matters now stand, the majority of practising radiologists have acquired their knowledge, since leaving the medical school and completing their internships, by serving as assistants to established radiologists or roentgenologists and by such supplementary study as the temperament of the individual and the exigencies of his position prompt him to undertake. The consequence is that many, even among those in high standing, possess only a superficial and often inaccurate knowledge of the basic principles of the subject. Adequate training in radiology must be a post-graduate function, but if it is to accomplish its purpose and exert a real influence, such instruction must be raised to a much higher plane than that of the majority of post-graduate courses available to-day. Few internists or surgeons have anything more than a general conception of the value of radiology, both for diagnosis and for treatment; few realize how much their own work could be improved by first-class radiology. This can never be corrected unless and until the instruction in radiology is improved—until hospital authorities require of radiologists more substantial training in the subject as well as a sound knowledge of clinical medicine. The value of the radiologist depends as much on his knowledge and experience in general medicine as in radiology. Practical experience in roentgen diagnosis and radiotherapy is important, but it can never be a substitute for thorough fundamental training.

Radiology should be brought into more intimate relations with clinical medicine and surgery, and these relations should be so adjusted that the radiologist or roentgenologist may be kept in close contact with clinical problems. His interest in such problems should be stimulated by every possible means and no longer should his knowledge of clinical medicine be allowed to atrophy by his being segregated or by his segregating himself. The radiologist is often to blame for such segregation, but hospital directors should take whatever steps may be necessary to correct the pernicious habit, even by refusing to employ one who has such a narrow conception of his work.

At the annual session of the American Medical Association in 1928, the Council on Medical Education and Hospitals was delegated to attempt to improve departments of radiology or roentgenology in hospitals, clinics and other medical institutions, and also the private practice of radiology and roentgenology. In the light of the considerations which I have outlined, it is obvious that the Council cannot correct all the defects described, the remedy for many of which must come from within the ranks of the specialty. Nevertheless, the Council can do much to ameliorate present conditions by establishing and enforcing minimum standards of training in radiology and in the practice of radiology or its divisions, and by requiring proper working conditions and those protective measures which are now recognized as indispensable to the safety of the patient and of the physician and his non-professional assistants. There are important questions which cannot be dealt with arbitrarily. Such is the problem of full-time or part-time service. In certain cities a number of hospitals may arrange with the same roentgenologist, who spends an hour or two at each hospital and the rest of his time at his private office. The apparatus may be owned by the hospital, in which event the radiologist may be paid a fixed salary or may work on a percentage basis. In other institutions the equipment is owned by the radiologist, who then receives a percentage of the revenue. Many abuses have crept in, and such abuses cannot be abolished by a stroke of the pen. The Council can attempt to correct only the gross abuses, and the remainder will diminish as the general situation tends to improve. If the radiologists and roentgenologists will co-operate actively and wholeheartedly with the Council on Medical Education and Hospitals, and if they will undertake to remedy by themselves those defects in the present situation which they alone can remedy, it will not be many years before the clouds which are now hovering over the specialty will be dissipated and radiology will be recognized as the peer of other medical specialties.

THE RADIOLOGIC DEPARTMENT IN THE HOSPITAL[1]

By CHARLES L. MARTIN, E.E., M.D., DALLAS, TEXAS

SINCE it is the purpose of this meeting to discuss the problem of improving radiologic departments, it seems fitting that I should first set down the factors that in my opinion are necessary for the maintenance of an ideal radiologic service in a hospital. For the sake of completeness it will be assumed that the hospital under consideration is a large one, although the smaller institutions with their limited facilities are probably more in need of help and advice.

REQUISITE FACTORS

1. *Proper Equipment and Housing.*—The selection of apparatus and its arrangement for hospitals of various sizes is no longer a very difficult matter. The excellent articles by Case[2] and Hickey[3] are helpful and the engineers supplied by the manufacturers are always ready to lend assistance. However, a housing for the department designed to preserve the health of the operators and to offer the maximum safety to both operators and patients requires considerable thought. This matter is so thoroughly covered by the recommendations of the British X-ray and Radium Protection Committee and the recommendations[4] proposed at the Second International Radiological Congress recently held in Stockholm that none of the details need be taken up in this short paper.

2. *Technical Procedure.* — The nonmedical personnel of the department not only should have a working knowledge of X-ray apparatus, developing and filing, but should be well versed in a standard technic for routine procedures, so that the work in various institutions may be similar. It is also desirable that a trained radiologist be in attendance, so that the more difficult methods may be available and new procedures may be devised for the unusual and puzzling cases. Fluoroscopy should be performed only by a medical radiologist with experience in the interpretation of screen images, since it requires as much skill and training as auscultation and percussion and is a dangerous procedure in the hands of the untrained.

3. *Record and Filing System.*—This item is so vital to a good radiologic department in a hospital that it will be considered in detail. The following are the necessary requirements:

(*a*) A system of fireproof compartments, preferably metallic drawers, in which all films, after being properly marked, may be stored for ready reference. Sufficient containers for the films accumulated in five years or even longer should be provided, and it is desirable that one or more illuminating boxes be placed near at hand in order that these films can be conveniently studied at any time.

(*b*) A system of cards or sheets arranged alphabetically in fireproof drawers each bearing a complete description of all the radiologic data obtained in examining a single patient together with the opinion of the radiologist in charge regarding the pathologic condition revealed. Copies of these reports should be attached to the patient's hospital record. The units in this system must be so constructed that data may be added from time to time when subsequent examinations are made.

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[1]Read before the Annual Congress on Medical Education, Medical Licensure and Hospitals, Chicago, Feb. 20, 1929. Reprinted by permission from the *Journal of the American Medical Association*, March 30, 1929, XCII, 1039.

[2]Case, J. T.: Roentgenology and Hospitals. New Orleans Med. and Surg. Jour., January, 1927, LXXIX, 500.

[3]Hickey, P. M.: Important Considerations in Planning X-ray Departments. RADIOLOGY, August, 1926, VII, 104.

[4]Standards of Measurement and of Protection (editorial). Am. Jour. Roentgenol. and Rad. Ther., December, 1928, XX, 553.

(*c*) A film museum. This consists of a series of labeled compartments in which films illustrating various types of pathologic conditions may be stored away in an orderly fashion. These compartments may bear such titles as "osteomyelitis," "bone tumors," or "pulmonary tuberculosis." With such an arrangement valuable films are added to the museum each day with very little effort, and in a short time a wealth of material is available for lectures, demonstrations, scientific papers, and comparison in making doubtful diagnoses.

(*d*) A system of folders filed alphabetically, each containing the history, physical examination, necessary laboratory reports, treatment prescriptions, and follow-up notes on patients receiving radiation therapy.

(*e*) A cross file of cards so arranged that the names of all patients with a single disease who have been treated may be obtained quickly. This file is of great value in preparing lectures, scientific papers, and statistics.

4. *A Properly Trained Radiologist in Charge.*—The qualifications of such a director should include:

(*a*) A degree in medicine from a Class A medical school.

(*b*) A command of the best technical procedures used in the diagnosis of disease by roentgen-ray methods.

(*c*) A thorough knowledge of the accepted principles of roentgenographic interpretation, with sufficient experience to insure a careful weighing of the data obtained on its merits. Constant contact with the rapidly changing radiologic literature is necessary and a properly kept reprint file in the department is a most useful adjunct. A man who writes good scientific articles himself is usually familiar with the writings of others, and the radiologist who is often found in the autopsy room and at the operating table is likely to be one who places the correct valuation on roentgen-ray observations.

(*d*) A knowledge of modern medicine sufficiently broad to make him a true consultant. Any physician on the staff should feel free to go to the director of the department for advice when requesting roentgen examinations with the feeling that his patients will thereby receive the most efficient service with the least possible lost motion. Unnecessary and improperly ordered roentgen examinations make up a large percentage of the work in many institutions. Free discussion of the observations after the work has been done is also often helpful.

(*e*) A broad knowledge of radiotherapy backed up by a reasonable amount of experience. A familiarity with electrophysics, particularly as it deals with dosage measurements, is necessary, but it is more important that the radiotherapeutist be versed in the diagnosis, course, and prognosis under treatment of the various types of malignant and other conditions treated. Better therapeutic work in the average radiologic department is probably our greatest need. Unfortunately, appropriate instruction in radiotherapy is not easily obtained and proficiency comes slowly.

(*f*) The ability and willingness to teach. Of course, the radiologist connected with a teaching hospital expects to devote a certain amount of time to lectures and demonstrations. It is desirable that his work be interlaced somewhat with the departments of anatomy, physiology, and pathology, as well as with many of the clinical divisions. However, the man in the non-teaching institution can appreciably improve the standing of his department by so arranging his work that the interns receive regular instruction. Interesting r a d i o l o g i c demonstrations should also appear on the programs of the staff meetings at regular intervals. Such endeavors require extra effort but they invariably bear fruit.

(*g*) Some familiarity with research problems. It is true that not every physician is fitted to do research work, but a surprisingly large number of radiologists have contributed some bit of knowledge of more or less importance to the specialty. Some have a mechanical tendency and have devised new technics or improved apparatus, while others have delved into the biologic problems of radiotherapy or have collected clinical data. Most departments have adequate facilities for work of this sort and a certain amount of creative effort invariably tends to redound to the credit of the department as well as to the institution as a whole. No specialty offers more interesting problems for investigation than does radiology.

COMMENT

It is evident from the foregoing outline that good radiologic service depends above everything else on the presence of a competent radiologist. An increasing number of hospitals are coming to regard their radiologic departments merely as sources of income. In many of these institutions the profits are obtained by eliminating the expense of trained supervision or by reducing it to such a minimum that the work suffers severely. This tendency seems to be most marked in hospitals controlled entirely by laymen. Naturally their interest leans toward the financial rather than the scientific development of the institution.

The highly trained radiologist undoubtedly finds his greatest field of usefulness in the hospital, but bright young men cannot be induced to prepare themselves properly for this field unless they are assured a position of dignity and an income comparable to that expected in other specialties requiring a similar amount of training. The truly ambitious man is happy only when he receives a fair share of the fruits of his labors.

The surgeon who uses the operating rooms, surgical instruments, and anesthetic equipment belonging to the hospital receives a fee for his work from the patient, and the hospital makes a charge for the use of the apparatus. A similar plan in radiologic departments would bring many good men into this field of work. Sweden has produced some remarkably fine radiologists, and Dr. Gösta Forssell[5] in a recent paper on the radiologic situation in that country says: "All of the roentgenological work for the whole hospital is centered in one central roentgen department under the direction of a first-class thoroughly trained radiologist who has his entire work—even his private practice—in the hospital." When the radiologist is encouraged to build up a private practice in the hospital, and this applies especially to therapeutic work, he is more likely to regard his hospital connection as a field of endeavor worthy of a number of years of preliminary study. He has a future of some promise so long as he continues to apply himself and to become more proficient in his work. Hospital departments of note usually derive their fame from the activities of one man, and as his reputation spreads the whole institution inevitably profits thereby. Many hospitals in which poor radiologic work is done have a constantly changing personnel in their radiologic departments. One radiologist after another undertakes the work on a small salary with the intention of leaving as soon as something better is offered. There is no incentive leading to the best type of endeavor in such a department and nothing other than the most meager routine procedures is carried out.

It is probably true, as some have contended, that the radiologic departments in this country far outnumber the properly qualified radiologists. However, adequate

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5Forssell, Gösta: Education in Medical Radiology, Am. Jour. Roentgenol. and Rad. Ther., December, 1928, XX, 474.

facilities for post-graduate instruction are now provided in many of the larger teaching centers, and an ample supply of highly trained men will appear rapidly so soon as the governing boards of hospitals see fit to raise their standards and demand high grade talent in their radiologic departments.

The radiologic committee, which is cooperating with the Council on Medical Education and Hospitals in this work, will attempt to formulate the minimum requirements that the members of the committee feel should be put into effect in an effort to stimulate hospitals and other institutions to improve their departments of radiology or roentgenology and to create a demand for highly trained directors of such departments. However, hospitals cannot expect to obtain the services of talented and well trained men until the institutional positions are made sufficiently attractive, and it is my earnest hope that the radiologic departments of the future will be directed by competent physicians who are really practising a specialty in medicine rather than by low salaried laboratory workers. Therein lies the hope of elevating radiology to its highest sphere of usefulness.

INTERMITTENT DUODENAL STENOSIS[1]

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THE question of duodenal ileus, or intermittent stenosis of the duodenum, is receiving, in recent years, a good deal of attention, due perhaps, in the main, to more refined X-ray diagnosis. The many masterly papers appearing from time to time both by roentgenologists and surgeons show that a good deal of thought is being centered on pathologic conditions in the duodenum other than the mere presence of ulcer or of very apparent deformity due to inflammatory adhesions from nearby pathology, and physicians in general are beginning to demand of radiologists a more exacting description of the behavior of the entire duodenum. The diagnosis of gastric neurosis, hyperacidity, neurasthenia, and cholecystitis, without proof thereof, is no longer quite a satisfactory explanation for a symptom-complex, usually bizarre, such as these cases often present.

It is now pretty generally conceded that non-inflammatory bands to the duodenum either above or below the mesocolon may cause intermittent obstruction and seriously interfere with the function of the duodenum. Whether these bands are congenital or not may not deserve serious discussion, but the fact that no other pathology is found at operation in this type of case favors the former theory.

This is the "essential periduodenitis" which Roux, Duval, and Béclère so elaborately describe in their masterly work on "Studies in the Duodenum," recently translated by Quain. Many years ago Cole called attention to these deforming bands or veils, as have also Quain, Carter, Taylor and others. The radiologist can by painstaking fluoroscopic examination (not overlooking lateral observation) almost invariably diagnose the presence of these bands. Too often, however, it may be said that the average physician fails to give diagnosis of these bands the consideration it deserves.

The type hitherto described as arteriomesenteric ileus due to mesenteric drag, while still being accepted by most physicians as a settled question, has not quite satisfied some of the best students of this condition as to its cause. It seems quite logical, as may be seen from a study of Case 1 (Figs. 1, 2, and 3), that the mesenteric root in which the superior mesenteric artery is incorporated may, when there is a congenital shortness of the mesentery with ptosis of the small intestine, exert sufficient drag to cause compression of the duodenum over which it passes, or that when we have a right-sided ptosis the colica media which supplies the right colon may exert sufficient traction on the main trunk to cause this same compression.

However, Fraser, writing in *Surgery, Gynecology and Obstetrics* for March, 1927, attributes the cause in this latter type to derangement of the involuntary nervous system, yet being convinced, as he says, that an imperfect attachment of the cecum and ascending colon to the abdominal wall is in fact a constant accompaniment of these functional disorders. Robertson, who also writes on the subject in *Surgery, Gynecology and Obstetrics,* says, in a personal communication discussing Case 1, that it is "unfortunate for these sufferers that the mesenteric root should cross the duodenum, for, conceivably, once the condition has been pro-

[1]Read before the Radiological Society of North America, at the Fourteenth Annual Meeting, at Chicago, Dec. 3–7, 1928.

Fig. 1, Case 1. See text.

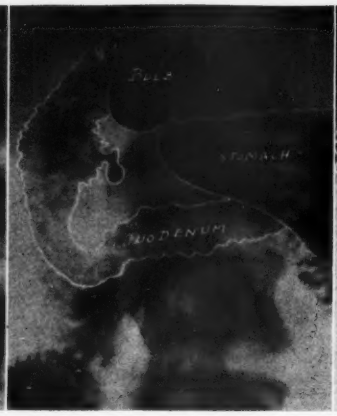

Fig. 2, Case 1. See text.

Fig. 3, Case 1. See text.

duced, the anatomical position of the mesenteric vessels may aggravate though never in my opinion to any serious degree," and he is insistent that disturbed innervation is the cause. The writer is of late inclining more to this latter view and hopes in a later paper to show that the question of superior mesenteric artery pressure is not the sole problem.

While working in the Cleveland Clinic gastro-intestinal department in 1924 and 1925, many cases of chronic duodenal ileus were operated upon, and a duodenojejunostomy performed in which no pathology was found other than that apparently due to superior mesenteric artery pressure from a right-sided ptosis or such as might come under the first class wherein non-inflammatory stenosing bands were found.

SYMPTOMATOLOGY

There is usually stomach trouble of long duration, often since childhood. Periodical so-called "bilious attacks," with nausea and often vomiting, resembling a typical migraine attack, are common and most significant, the attack often being ushered in by marked constipation and usually accompanied by headaches which in the female are independent of the menstrual period. True migraine is, however, an entirely different entity. Females to males are in the proportion of two or three to one, and the usual age period of "full-blown" attacks is between twenty and forty, but children may present the same symptoms. Pain may be violent or absent, its situation variable, as well as its relation to food or its being eased by food or soda.

Some certain posture may often give relief, especially when occlusion by root of mesentery is at fault. While constipation is the rule, there are often intermittent diarrheal attacks. Cecal stasis may dominate the picture, especially when there is a right-sided ptosis, the duodenal compression being secondary, due to drag on the colica media. If the duodenal compression is in the region of the ampulla of Vater, we may have an enlarged and sensitive liver and gall bladder, with pain in the region of the right costal arch.

There is often loss of weight and strength, with mental and physical depression, disturbed heart action, cold extremities, hyperesthesia, paresthesia, skin eruptions, low blood pressure, subnormal temperature and other evidence of duodenal intoxication. Buchanan says: "Bilious attacks are practically always a part of migraine and not of something more serious;

Fig. 4, Case 2. See text.

Fig. 5, Case 2. See text.

Fig. 6, Case 2. See text.

the first evidence of the migraine character may occur in infancy as cyclic vomiting, and the prediction can be made with a high degree of assurance that the child will be subject to migraine cycles later in life."

With such symptoms persisting over a long period, a state bordering on neurasthenia may well result, and one's first impression often is of a functional element of exaggeration. Hence the frequent diagnosis, "gastric neurosis."

ETIOLOGY

Of our present series of forty-eight cases all have had a very complete examination, both clinically and radiologically, with repeated rechecks. The Graham "dye test" for gall-bladder visualization was carried out in the adults; the appendix region was carefully inspected at the time of the X-ray examination, and consultation had with nose and throat specialists with reference to sinus pathology.

In nineteen cases operated on, of the entire series from which this study is made, no other pathology was found than that due to membranes or supposed mesenteric pressure. There is much controversy with regard to the cause in arteriomesenteric ileus: that it is due to a neuromuscular derangement above the duodenal rudimentary sphincter is now being given serious consideration by many able writers. On the other hand, there seems to be a majority that favors the superior mesenteric artery pressure theory.

McKenty found a right-sided ptosis in nineteen out of his twenty-six cases, and with one exception the only cause was compression by the root of the mesentery. McConnell found a right-sided ptosis in thirty-seven out of thirty-eight cases. Nesbitt had four cases in his wards at one time, upon three of which he did a cecopexy. Wilkie says two conditions are responsible: (1) empty small intestines hanging over the pelvic brim without resting on the floor of the pelvis, the mesentery being then folded like a fan and exerting a uniform drag in the vertical direction; (2) congenital lack of fixation of the proximal colon, where the cecum and ascending colon prolapse into the pelvis—in other words, a right-sided ptosis, and exact traction on the mesentery in the line of the superior mesenteric artery.

Rehfuss says chronic stenosis of the duodenum is not uncommon, and gives pressure of the mesentery or superior mesenteric artery as one of the causes of the intermittent

Fig. 7, Case 3.

Fig. 8, Case 4.

Fig. 9, Case 5.

type. Béclère names compression of mesenteric vessels as one of the chief causes and stresses the fact that the condition is best shown at upright fluoroscopic examination, as it may disappear in the prone position.

Horsley mentions pressure by the superior mesenteric vessels and also emphasizes that the examination should be made during the symptom period.

The Kelloggs, in their exhaustive paper, also subscribe to compression of the duodenum between the vertebral column behind and the superior mesenteric artery in front.

Halpert differentiates the arteriomesenteric drag from the arteriomesocolic, suggesting a duodenojejunostomy for the former and for the latter a resection of the cecum, or colopexy.

Brams, adding a further series of ten cases to those already reported by him on "Migraine with Abdominal Equivalent," states that in the five of these ten cases operated upon no pathology was found. We feel that here the mesenteric pressure, resulting from mobile ceca and ascending colon, may have been at fault, the condition being easily overlooked by the surgeon unless specifically sought for.

Quain lays the blame on the radiologist for not discovering evidence of periduodenal membranes and of pathologic duodenal retention more frequently. We accept the blame but only to the extent of about 25 per cent. The surgeon and internist will have to accept the rest until they familiarize themselves with the possibilities of screen study in these cases, and make more specific inquiries as to the behavior of the distal duodenum after ingestion of the barium meal.

Of recent articles, the very excellent and comprehensive study by Carslaw, of Edinburgh, on Visceroptosis will well repay careful perusal.

DUODENAL INTOXICATION

A proper conception of this condition fails us, unless we have a thorough understanding of duodenal physiology. In spite of the relative mildness of the motor troubles, there may be evidence of profound duodenal intoxication. Peristaltic contractions as well as rhythmic contractions of the duodenum, according to Wheelon, assure a passage of food through the duodenum in from eight to ten seconds, and Holzknecht, of Germany, gives the same time. So that in duodenal stenosis, instead of fragmentary evacuation, intermittent and rapid, the food fills the duodenum and distends it during the entire

Fig. 10, Case 6.

Fig. 11, Case 7.

Fig. 12, Case 7.

duration of gastric digestion. The farther along in the duodenum the obstruction, the graver the symptoms. They are but slightly marked in stenosis of the duodenal cap, which we are not here considering.

The cause of the symptoms is not yet elucidated, as the exact nature of the poisons is unknown: (*a*) according to some authors the toxic substances are created by the duodenum; (*b*) according to others they are produced at the expense of duodenal secretions under the influence of bacteria which develop in the stagnant duodenal secretion. Maury, Whipple (American authors), Roger and Garnier (French authors), say it is a toxic secretion. The Dragstedts claim that it is an alteration of the duodenal retained secretions by proteolytic bacteria and that duodenal secretion without stagnation is not extremely toxic.

It is the relative retention of the toxic contents in the duodenum, which in general is traversed so rapidly, that facilitates absorption there, and this absorption is the more rapid as pressure in the obstructed loop is raised (the "intraduodenal tension" of which Rehfuss speaks) and as the peristaltic movements are increased. In the pro-

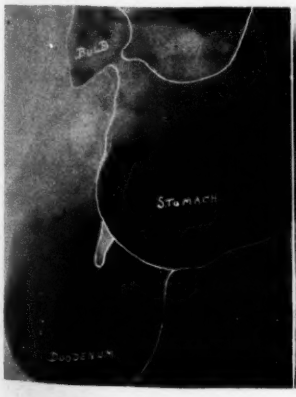

Fig. 13, Case 8.

Fig. 14, Case 9.

Fig. 15, Case 10.

Fig. 16, Case 11.

Fig. 17, Case 11.

Fig. 18, Case 12.

duction of symptoms, according to physiologists, the factors which increase intestinal absorption are more important than those which produce toxins.

RADIOLOGIC TECHNIC

The technic used can best be followed by a careful study of the cases described. The radiologist must always remember he is a physician and not merely a technician. He should have a history of the case submitted beforehand or obtain it for himself at the time of examination. Consultation with the surgeon or internist is the ideal, but as to the scope and manner of examination the radiologist should act entirely on his own initiative.

"Studies on the Duodenum," by Duval, Roux, and Béclère, has been the source of much inspiration and of many valuable suggestions.

The especial thanks of one of us (R. H.) are due to his colleague, Dr. Shaw, for his ideal co-operation and for having written the outline of the treatment he is using in these cases.

CASE REPORTS

Case 1 (Figs. 1, 2, and 3). Female, 40, sick headache all her life, "even as a girl." When first seen the present attack had lasted for one month; vomiting almost daily; patient practically bedridden; marked loss of weight; being fed alkalies. Previous roentgenogram at large clinic was negative. We insisted that patient be brought to the office "during the attack."

In Figure 1, note the dilated duodenum, with no barium passing into the jejunum. This film was taken at the end of 2½ hours. Fluoroscopic examination during this period showed marked writhing or churning movement of the barium in the duodenum. The foot of the bed was then raised, with patient on her abdomen. Observation at the end of two hours more showed the stomach and duodenum entirely empty. (Cf. Fig. 2.)

Figure 2 was taken after five weeks' medical treatment, during which the patient gained 30 pounds in weight. Her vomiting stopped after the first day of treatment. The barium passes immediately through the duodenum. Had this been the first examination of the patient, what would the diagnosis have been? (Cf. Fig. 3.)

Figure 3 was taken after ten months, with patient beginning to lose weight through overwork, worry, etc. The entire duodenum is seen on the print and marked churning movement was seen fluoroscopically. Barium at intervals passes into jejunum.

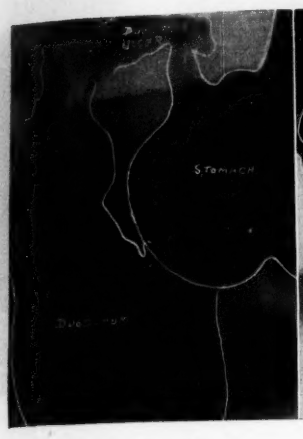

Fig. 19, Case 13.

Fig. 20, Case 14.

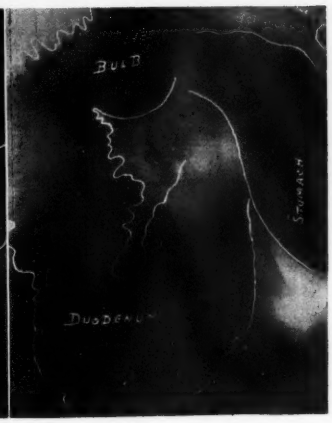

Fig. 21, Case 15.

The condition here is not so marked as in Figure 1. We cannot conceive of the intermittent obstruction here being due to other than a pure arteriomesenteric drag. The clinical history, with the abnormal mobility of cecum and ascending colon which this patient had, should determine the diagnosis, no matter at what stage the examination was made. The diverticulum in the duodenum is of no significance here. Is it, however, due to the intraduodenal tension present in these cases? (See also Figs. 25 and 35.)

Case 2 (Figs. 4, 5, and 6). Female, 38 years of age. Since the age of four, there had been periodical attacks of vomiting, with headaches. Duration of present attack, once a day for two weeks.

The film shown in Figure 4 was taken with the patient upright during fluoroscopic examination. Unless the behavior of the duodenum is observed fluoroscopically with the patient upright, many cases will be missed.

Figure 5 was taken at the same examination as Figure 4, with the patient prone. This woman has also a high fixed immobile hepatic flexure. The duodenal dilatation is readily seen in the prints. *X-ray diagnosis:* Intermittent duodenal stenosis due to abnormal bands; probably hepatoduodenal colic. Figure 6 is a film of this same patient taken at the end of five weeks' rest in bed with but little improvement clinically. Nothing is seen here in the duodenum to suggest the diagnosis so evident in the two preceding films. Operation was advised.

Case 3 (Fig. 7). Male, 64 years of age. Severe attacks of left-sided pain, with vomiting, for many years. Present attack is severe. Patient is losing weight. *Clinical diagnosis:* Carcinoma of the stomach. *X-ray diagnosis:* Stomach and bulb normal, marked duodenal dilatation, with stasis. Patient examined in upright position. Note gloved hand to push stomach out of the way. Not operated on.

Case 4 (Fig. 8). Female, 31 years of age. Nine months' search at largest medical centers for relief from "migraine." Symptoms lasting ten years. Severe headaches, with nausea and vomiting. Stomach pushed aside by ungloved hand to show dilated duodenum. In addition, this patient had a hugely dilated mobile pelvic cecum. Medical treatment here is resulting in some slight improvement.

Case 5 (Fig. 9). Female, 21 years of age. Epigastric pain, with vomiting and right-sided headaches every two weeks for

Fig. 22, Case 16.

Fig. 23, Case 17.

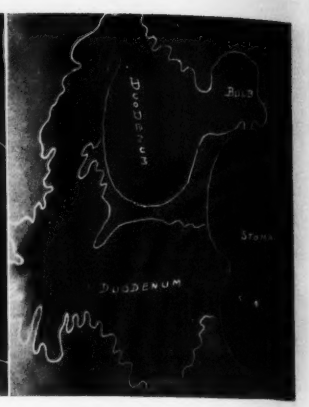

Fig. 24, Case 18.

one year. Dilatation of duodenum evident. Not followed up to determine mobility of cecum. Surgical treatment not advised.

Case 6 (Fig. 10). Male, 51 years of age. Severe bilious attacks over many years. Headaches now lessening, but severe vomiting spells occasionally. Dizzy, "dopey," "below par." All kinds of diagnoses, one contradicting the other, had been made. Is the duodenum here pictured, plus a mobile cecum, the cause?

Case 7 (Figs. 11 and 12). Male, 34 years of age. Headache and stomach trouble for fifteen years. Headache not relieved until patient vomits. May vomit every five minutes for three or four hours. Dizzy spells. Constipated. Note large pouch at knee of duodenum—this held traces of barium for twenty-four hours. Operation advised, but refused as a previous appendectomy was to have cured.

Case 8 (Fig. 13). Male, 28 years of age. Attacks of epigastric distress, with nausea and vomiting, for four years. *Clinical diagnosis:* Duodenal ulcer. *X-ray diagnosis:* Evident from Figure 13. *Operative diagnosis:* Adhesions at duodenojejunal junction from inflammatory mesenteric glands.

Case 9 (Fig. 14). Male, 35 years of age. Repeated bilious attacks, with headaches. Stomach of hypersthenic type. Gall bladder removed, without relief. Note stasis in knee of duodenum beneath transverse colon. Patient had had barium elsewhere the day before in search for stomach pathology.

Case 10 (Fig. 15). This patient had dilated duodenum, as seen, and also a marked right-sided ptosis. Surgeon at operation reported a normal gall bladder and appendix, the latter being removed. The question of the dilated duodenum was apparently not considered.

Case 11 (Figs. 16 and 17). Female, 37 years of age. Little or no history obtained in this case. Severe attacks of gastric distress warranting operation. Figure 16, taken prone, shows the dilated duodenum; Figure 17, taken upright, after three hours, shows the stasis or puddling in the duodenum. *Operative diagnosis:* Adhesions of liver and duodenum, causing dilatation.

Case 12 (Fig. 18). Female, 47 years of age. For twenty years there had been constipation, nausea, headaches, vomiting frequently. *Clinical diagnosis:* Asthenia, migraine. *X-ray diagnosis:* Intermittent stenosis, due to anomalous bands. Note that the entire duodenum is seen at one time.

Fig. 25, Case 19.

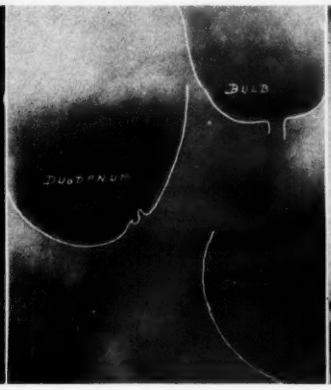

Fig. 26, Case 20.

Fig. 27, Case 21.

Operative diagnosis: Duodenum two and a half times its normal size, due to abnormal bands.

Cases 13, 14, 16, 17, 18 (Figs. 19, 20, 22, 23, and 24, respectively). These cases show the dilatation often accompanying a duodenal ulcer, as well as occasional traction pouch. Such a combination is too frequent not to be more than a coincidence and suggests the following queries: Is the dilatation primary? Do such cases do badly under treatment with alkalies, owing to tendency to alkalosis in high intestinal stasis? Do such cases do badly with a gastro-enterostomy, if the dilatation is overlooked? The large series of such cases reported by Dr. Sloan, of Bloomington, with cure of the ulcer following duodenojejunostomy for the dilated duodenum, is worthy of serious consideration.

Case 19 (Fig. 25). Male, 22 years of age. History of severe spells of abdominal cramps and nausea since the age of eight years. At present the history is suggestive of duodenal ulcer. *X-ray diagnosis (from film):* Duodenal ulcer. *Fluoroscopic diagnosis:* Duodenal diverticulum, and the unusual "cup and spill" type of descending duodenum, due, no doubt, to constricting bands. Is the latter abnormality the cause of the symptoms dating from childhood, as also of the duodenal ulcer present now, and of the diverticulum, owing to intraduodenal tension present in such cases?

Case 20 (Fig. 26). Female, 30 years of age. This case illustrates the duodenal stasis of a true gastroptosis, with its own train of symptoms. This statement is made while the writer is quite mindful of the excellent work of Moody, Van Nuys, Chamberlain, Wingate Todd and others. Gastroptosis *per se* is no factor in the types with which this paper is concerned.

Case 21 (Fig. 27). Little girl, aged 8. So-called "cyclic" attacks of vomiting. This case is shown here as we are convinced that such attacks in children come under this class of intermittent duodenal stenosis. In eight cases under observation at present we find the same anomalies in the intestinal tract as described in this paper. Colon redundancies or other anomalies than those described here are coincidental. The removal of the appendix is not the solution of the problem. Note in the many histories of adults here reported the number dating their attacks back to childhood.

Cases 22, 23 (Figs. 28 and 29, respectively). These two cases are clinically as characteristic of duodenal stenosis as Case 1. Cases 22 and 23 had just as severe attacks.

Fig. 28, Case 22.

Fig. 29, Case 23.

Fig. 30, Case 24.

Both have mobile ceca. Examination was made in the interval between attacks. The dilatation of the duodenum, as can be seen, is not very marked. Fluoroscopic observation shows the same to-and-fro churning movement in the duodenum. We have no hesitation as to the diagnoses to make in these two cases.

Case 24 (Fig. 30). Male, 47 years of age. Recurrent headache all of life; attacks may last from twelve hours to three days, completely incapacitating patient for his very responsible position. Diagnosis made fluoroscopically with patient upright. No diagnosis possible from this film, taken when the patient was prone. Duodenojejunostomy performed. In this case, at least, judging from the almost complete relief for two years, this type of operation seems to have justified itself.

Case 25 (Fig. 31). Female, 15 years of age. Nausea and vomiting every morning for three months. Considerable loss of weight. X-ray diagnosis evident from film. Operation being considered.

Case 26 (Fig. 32). Female, 32 years of age. Characteristic history. Diagnosis of dilated duodenum made elsewhere and operation advised. At this examination, made in the interval, the dilatation is not marked, while, if made during an attack, it may be as marked as in Figure 1, Case 1.

Case 27 (Fig. 33). Male, 23 years of age. Indefinite history of gastric distress, with periodical attacks of nausea and vomiting, since age of eight. Duodenal bulb is

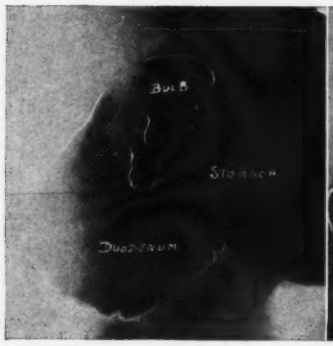

Fig. 31, Case 25.

Fig. 32, Case 26.

Fig. 33, Case 27.

Fig. 34, Case 28.

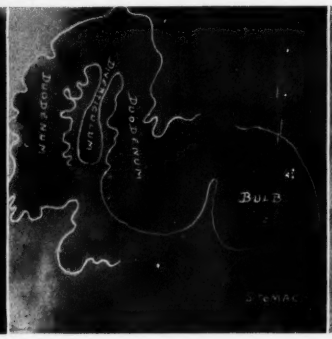

Fig. 35, Case 29.

Fig. 36, Case 30.

normal; deformity of distal duodenum is undoubtedly due to hepatoduodenal bands, probably congenital in origin.

Cases 28, 29 (Figs. 34 and 35, respectively). These cases illustrate the distortion of the duodenum due to anomalous bands. The question will always be raised as to whether a pathologic gall bladder with resulting adhesions is not the cause. As in Case 27, many patients will date their symptoms from childhood and the conservative surgeon will often report a normal gall bladder in those cases, the bands being congenital in origin and non-inflammatory.

Case 30 (Fig. 36). Megaduodenum in a child three and one-half years old. Symptoms justified clinical diagnosis of pyloric stenosis. Operation revealed a hugely dilated duodenum due to obstructive bands in region of ligament of Treitz. Complete relief from duodenojejunostomy.

TREATMENT

Treatment should be undertaken only by one familiar with the orthopedic principles involved, and with the malstatics which in our opinion are the result, not the cause, of the intestinal tract anomalies found, and by one who has familiarized himself with the X-ray evidence by screen observation.

The matter of diet assumes an important rôle, since only by marked gain in weight may intra-abdominal fat be deposited and thereby intra-abdominal pressure raised. Instead of eliminating carbohydrates, eggs, milk, etc., from the diet, these, together with fats and sugars, are forced. Milk and cream with meals and at bedtime are prescribed, with also a light mid-morning meal. Olive oil is taken before each meal. Printed detailed diets are furnished each patient.

Attention to posture and malstatics is observed by absolute rest in bed for seven weeks, with the foot of the bed elevated ten to twelve inches. By thus overcoming intestinal drag and abnormal bowel kinks, stasis theoretically is lessened. In fact, many of these cases treated thus are less constipated than when leading an ambulatory life. In addition, gradually increasing exercises are outlined, the object of which is to increase the muscular tone of the lower abdominal wall, to expand the upper abdomen, and to contract the lower.

Post-feeding distress is commonly relieved by turning the patient on the right side or abdomen for one hour after each meal, often happily combined with the application to the abdomen of local heat. Cathartics are avoided, except when necessary, and then a weekly saline may be given and a daily evacuation of the colon obtained by glycerine suppository or small saline enema. Hardened stool may be softened by an in-

jection, retained over night, of four to six ounces of cottonseed oil. A properly fitting and specially designed belt is furnished at the end of the bed period, this to be laced in place in the Trendelenburg position.

The above routine is continued for several months, with the addition of gradually increasing walking exercises to the extent of four to five miles a day. Patients are cautioned that symptoms are apt to recur with any marked loss in weight or relaxation in application of the treatment.

The whole problem is essentially a medical one, although certain associated factors of medical treatment are unsatisfactory. However, we believe that any surgical approach should be undertaken with extreme reluctance. Distorting bands, membranes, or adhesions about the duodenum or elsewhere may be severed and raw surfaces carefully covered. Where this seems impossible, duodenojejunostomy may be considered if a grossly dilated duodenum is noted. Our experience with cecal plication and fixation or colopexy has not been encouraging. X-ray follow-up after two years of cases operated upon finds the cecum in the pelvis practically as it was before operation.

BIBLIOGRAPHY

BLITZSTEN, N. L., and BRAMS, WILLIAM A.: Migraine with Abdominal Equivalent. Jour. Am. Med. Assn., March 6, 1926, LXXXVI, 675.

BUCHANAN, J. A.: A Consideration of the Migraine Character. Colo. Med., September, 1922, XIX, 179.

CARSLAW, ROBERT B.: Right-sided Visceroptosis: An Estimate of the Importance of Abnormal Mobility and Prolapse of the Ascending Colon and Cecum in the Causation of Various Abdominal Conditions, Based on Observations in a Series of 242 Cases Treated by Right Colopexy. Brit. Jour. Surg., 1928, XV, 545.

CARTER, L. J.: Intestinal Bands and Intestinal Adhesions—Differential Diagnosis and Treatment—A Plea for More Accurate Nomenclature. Can. Med. Assn. Jour., March, 1924, XIV, 212.

DRAGSTEDT, LESTER R., MOORHEAD, JAMES J., and BURCKY, FRED W.: Intestinal Obstruction: An Experimental Study of the Intoxication in Closed Intestinal Loops. Jour. Exper. Med., March, 1917, XXV, 421.

HALPERT, BELA: Arterio-mesenteric Occlusion of the Duodenum. Johns Hopkins Hosp. Bull., June, 1926, XXXVIII, 409.

HORSLEY, JOHN S.: Surgery of the Stomach and Small Intestine. D. Appleton & Co., New York and London, 1926.

KELLOGG, E. L., and KELLOGG, W. A.: Chronic Duodenal Obstruction with Duodenojejunostomy as a Method of Treatment: Report of 41 Operations. Ann. Surg., May, 1921, LXXIII, 578.

MCCONNELL, A. A.: An Address on the Surgical Significance of the Ascending Mesocolon. Irish Jour. Med. Sci., September, 1924, 5th ser., 402.

MCKENTY, J.: Chronic Duodenal Stasis. Surg., Gynec. and Obst., April, 1924, XXXVIII, 444.

MAURY, J. W. DRAPER: Observations upon a Form of Death Resulting from Certain Operations on the Duodenum and Jejunum, with the Determination of a Lethal Line for Experimental Purposes. Surg., Gynec. and Obst., May, 1906, II, 502.

NESBITT, GEORGE E.: Partial Duodenal Obstruction as a Cause of Chronic Dyspeptic Symptoms. Irish Jour. Med. Sci., April, 1924, 5th ser., 147.

QUAIN, E. P.: Periduodenitis: A Discussion of its Causes, Types, Symptoms, Diagnosis, and Treatment. Minn. Med., August, 1926, IX, 431.

REHFUSS, MARTIN E.: Organic Duodenal Pathology. Med. Clin. N. Am., September, 1926, p. 441.

ROBERTSON, GEORGE: Acute Dilatation of Stomach and Intestinal Tube, with a Consideration of "Chronic Duodenal Ileus." Surg., Gynec. and Obst., February, 1925, XL, 206.

ROGER, H., and GARNIER, M.: L'occlusion Intestinale: Pathogenie et Physiologie Pathologique. Presse Med., May 23, 1926, No. 41, p. 325.

SLOAN, E. P.: Partial Obstruction at Duodenojejunal Junction as Cause of Ulcer of Duodenum. Jour. Am. Med. Assn., April 7, 1923, LXXX, 977.

TAYLOR, ALFRED S.: Anomalous Abdominal Membranes: Their Influence upon the Digestive Tract. Ann. Surg., May, 1922, LXXV, 513.

WHEELON, HOMER: Observations on Gastric and Duodenal Motility in Duodenal Obstruction. Jour. Am. Med. Assn., Oct. 29, 1921, LXXVII, 1404.

WHIPPLE, G. H., RODENBAUGH, F. H., and KILGORE, A. R.: Intestinal Obstruction. Jour. Exper. Med., January, 1916, XXIII, 123.

WILKIE, D. P. D.: Chronic Duodenal Ileus. Brit. Jour. Surg., 1921, IX, 204.

PROGNOSIS IN CANCER[1]

By M. J. SITTENFIELD, M.D., New York City

IT seems to me the time is ripe, particularly in this kind of an assembly, to formulate from our results the prognosis in malignant disease, especially in the face of the very active campaign for cancer control, and the greater information accumulated on the subject of cancer in general, and to discuss with you the means for advance in the fight against cancer.

If we go back fifty years or so to the days of Pasteur and Virchow, we find that the treatment of cancer was only haphazard at best, and based upon ignorance and empiricism. At that time the most unheard of therapeutic agents were suggested, from the application of elixirs and other absurd potions to placing twenty green frogs on a so-called cancer to suck away the malignant principle.

Through the new developments of bacteriology and pathology at that time, the general interest in cancer was transformed to surgery, so that in a comparatively short time cancer surgery made more progress than had been made during the many centuries preceding. Notwithstanding, however, the development of a highly perfected surgical technic, the prognosis of cancer has not changed very materially, and it is difficult to conceive how more extensive surgical measures are going to bring about a further progressive change in the prognosis of cancer. The very fact that there is a constantly changing attitude in the attack upon cancer would indicate that the present-day methods are either non-satisfying or disappointing, and that is why new means of combating the disease are constantly sought for.

With this in mind, let us consider only two of the most outstanding questions: Firstly, whether, by virtue of the improved surgical technic within the last twenty-five years, the prognosis in cancer is better to-day than it was at that time, and secondly, have the activities of the different cancer societies urging the prevention and early treatment of malignant disease by prompt radical surgery reduced the cancer incidence or cancer mortality in the slightest?

To answer the second question first, it is generally admitted that the urge for the early recognition and early extensive excision of cancer has not made the least dent in the mortality rate. This is true even in the largest cities where every facility for the most efficient type of work is available. Compare the percentage of deaths from cancer in New York City twenty-five years ago with that of to-day, and you will be startled and unable to account for the increased number in the death rate. The attempt to explain this upon the basis of improved diagnostic methods would have to face the fact that diagnostic methods, say fifteen years ago, were not inferior in general to what they are to-day, and if these methods are better to-day, then a larger number of early or operable cases of cancer should have been recognized, and these should have lent themselves to a better prognosis. Especially should this be true of the breast, skin, uterus, or lip cancers—the most favorable types for early surgery. This, however, has not been borne out by mortality statistics, as the fatalities in this group of cases have not been lessened.

This state of affairs naturally confronts us with this question, Are we on the right track in considering cancer truly a surgi-

[1]Read before the Radiological Society of North America, at the Fourteenth Annual Meeting, at Chicago, Dec. 3–7, 1928

cal disease, and can we hope for better results from a more radical surgical procedure, or are these cases hopeless from the start? As a matter of fact a surgical excision is hardly ever radical enough or else we would not meet with recurrences. Again, if we look upon early extensive operation as meeting all the requirements in a given case of cancer, then the cold fact confronts us that an individual with a cancer, even after a wide and extensive excision of the tumor, is not cured of the disease, but for all intents and purposes remains afflicted during his entire lifetime. We know only too well that patients who remain symptom-free for five years or so, after extensive surgical removal of the tumor, do succumb after six or eight or even ten years from a recurrence, either in the field of operation or from metastases in organs distant from it.

The very fact that the disease recurs in the scar or in the field of operation, the prevention of which was planned by the complete excision of the tumor, makes two probabilities apparent: One, that it was impossible to completely remove all the malignant tissue by the knife; the other, that some cells were dispersed or set free into the tissue during the operative manipulation.

This factor, combined with many others, makes the prognosis in cancer quite difficult, especially so when we keep in mind the extraordinary length of time that sometimes elapses before these isolated and dispersed cells come to a new outbreak—after five or even ten years or more.

There is abundant evidence for this possibility of recurrence, apparently, for the rest of the individual's lifetime, and frequently this hazard is not sufficiently appreciated. Such late recurrences have formerly been looked upon by pathologists and clinicians as somewhat rare occurrences, but recent studies upon this very question by the Medical Society of London have brought to light very interesting information. From a follow-up of cases operated upon for carcinoma of the breast, 265 individuals were traced who had survived a period of ten years or more. Astonishingly enough, within the next three to five years 73 per cent of these died from recurrences of the cancer. We are in close agreement, therefore, with one of the leading English surgeons, who says: "The most admirably planned radical operation according to the best anatomical and surgical knowledge depends upon a certain amount of luck or chance for success."

There is much to support this notion by virtue of the fact that the spread of the malignant cells in the organism is by no means uniform. In cancer of the breast, for instance, the disease may spread in the direction of the lymph flow, either as isolated cells or emboli, or they may be carried by a continuous process against the stream. Anatomists have shown that the current in the lymphatics is not always in one direction, also that the relays are such that the regional glands are not invaded in their regular order. For example, some cells travel by way of the axillary glands, others through the intercostal channel, others, again, downward along the superficial fascia, whilst still others go to the opposite breast, and so on.

To put this in a more concrete form, no one can foretell the particular path that a cancer cell may or has taken; at best, one can only assume the average picture. Because of the various paths that a cancer cell may take and the fact that isolated groups lie quiescent for many years without lighting up, will make it questionable whether at any time they can be brought under the control of the knife. Moreover, the spread of the cancer may be extrathoracic or intrathoracic. So too, some neoplasms are long-lived, others short-lived. This phase of ma-

lignancy has brought about such a distressing situation that surgeons like Moynihan and Patterson express themselves as follows: "Among thoughtful surgeons there is a growing feeling of dissatisfaction and disappointment at the results of operation in cancer, and furthermore it must be recognized that extensive operations in advanced cases confer no benefit; indeed, do harm."

Statements coming from such authorities should cause us to pause and reflect upon what is the proper thing to do in a given case of cancer, and what procedure promises the most favorable prognosis.

The responsibility in a given case of cancer after all falls either upon the surgeon or the cancer specialist, and only too frequently the responsible one fails to question himself, especially after the surgical removal of a tumor, as to whether or not all that can be done has been offered to the individual afflicted with cancer. Right here it is especially appropriate to point to the fact that the cancer specialists who employ the radioactive substances in malignancy have failed to emphasize sufficiently the value of these, and for the most part have failed to speak a common language upon this important problem. This is regrettable, insofar as in some quarters irradiation has been discarded as an adjunct to the surgical procedure, and only the inoperable and advanced cases are subjected to irradiation.

In this connection may I be permitted to borrow the remarks of Dr. W. J. Mayo before this Society two years ago: "It would appear that radiotherapy to some extent is selective in its effect. In one, radiotherapy will cause a complete disappearance or perhaps cure the disease; in another, only the most meager palliation will result. In highly cellular growths radiotherapy has a wide field of usefulness. When it is intended to secure a direct effect upon a limited area, radium has many advantages, and for cancer of the cervix, radium at any stage, even early, gives apparently a prospect of cure equal to that of the knife, and at less risk. In the case of extensive cervical cancer, radium may cure, when the knife would be essentially valueless. The difficulty in evaluating radium and X-ray in the treatment of cancer lies in the fact that they are used so largely in treating cases of inoperable cancer, or of metastatic cancer following operation, where the most that can be expected is palliation. The thoughtless give these agents little credit for what they actually accomplish and, often disappointed that the impossible has not been accomplished, minimize their value."

I do not think that it is an exaggeration to say that no one branch of medicine has made such progress in the past fifteen years as that concerned with the X-ray and radium, both in the diagnosis and in the treatment of cancer, yet it is incredible to hear from time to time some individual who claims never to have seen any benefit in cancer from radio-active substances.

As a refutation of this, let us refer to the report of Lahm on the end-results of surgery and radiotherapy in carcinoma of the cervix. In a series of 2,000 cases collected from 17 different clinics, he finds that approximately 20 per cent of cases remain symptom-free for five years when treated surgically, and, remarkably, the same percentage holds when radiation alone is employed; but in the inoperable cases in which surgery is of no avail, radiation alone gives an additional 6 to 10 per cent of five-year cures.

After all, the encouraging results obtained in cancer are from the first period of a method comparatively new, and still under development. Similar results are published from reliable and well conducted clinics abroad as well as in this country in cases of carcinoma of the breast, lip, and

lymphoid tissues in the hands of competent cancer specialists.

The same conditions in prognosis hold true for radium and X-ray as they do for surgery. In other words, no one can foretell from the clinical or histologic picture the severity of the malignancy, whether the disease may last twenty years or terminate within a few months. A great deal has been written within the past few years about the degree of differentiation of the cancer cell from the normal on its morphologic basis. Broders and MacCarty are particular disciples of the histologic interpretation of von Hanseman's anaplasia. According to von Hanseman, the degree of anaplasia or differentiation in a cell is identical with the degree of malignancy. Marchand and a number of other leading pathologists have not accepted this, and suggest that the non-differentiation of a tissue is purely secondary, depending upon nutritional conditions and other factors.

Not to dwell too long upon the histologic phase of prognosis, it would seem that the duration of the disease, the rate of growth, the size of the tumor, the infiltrative and destructive character of the growth, and the presence or absence of metastases are of the greatest significance. Cell function and cell activity do not go hand-in-hand. Furthermore, the histologic picture of the tumor may change at any time, and frequently does change during the progress of the disease. On the other hand, it is almost needless to draw attention to the metastases which form from apparently benign primary tumors. Only then may a prognosis be permissible from the histologic specimen, when one can assume that the morphologic structure of the tumor is homogeneous throughout and will run true to form, *i.e.*, that its pathologic as well as its biologic character is not going to change later on in the disease. The importance of secondary reactions, as metastases, local extension, pressure and obstruction, infection and absorption of toxic products of the tumor, must be kept in mind, not forgetting the defensive factors of the individual himself. In brief, then, the histologic character of a tumor will yield but little information regarding the prognosis of the disease if it does not hang together with the most minute clinical data, and also with the constitutional factors of the individual, and all these then co-ordinated into an ensemble. After all, no one fixed rule will hold in the prognosis of cancer—the organ involved and the individual himself are the important elements in the prognosis.

The surgeon who simply excises the tumor, no matter how widely, and the radiotherapist who radiates the field of operation or the region of the lesion alone, unmindful of its spread, are wrong in their view of the perspective of the picture.

In conclusion, permit me to draw attention to the fact that it is highly desirable that the surgeon as well as the radiotherapist acquaint himself better with the subject of cancer in general. It is essential that he familiarize himself with the pathology and histology and radiosensitivity of cancer, also its various paths of metastasis, that he may be on the lookout for secondary manifestations rather than waiting until the metastases have reached such size that they cast their death warrant shadows. Perhaps it is not going too far to say that the surgeon who operates for cancer should devote himself entirely to cancer surgery as a specialty. It seems highly unscientific that in every case of cancer of the breast, for instance, the same orthodox surgical procedure is adopted, taking no heed of the duration of the disease, the size of the tumor, the localization of the tumor, or what the defensive factors of the individual may be. Seemingly the notion still prevails in many quarters that surgery alone offers the only hope in cancer, because it has been the or-

thodox method for a great many years. Unfortunately, however, figures cited by Wood, Shore, and a number of other observers elicit the startling fact that anywhere from 75 to 85 per cent of the cases admitted to the larger hospitals in New York City are already of the inoperable type. These alarming figures confirm our convictions that in a vast majority of cancer cases surgery alone has little to offer. Therefore the prognosis of cancer, as we see it, must not leave out of consideration the 75 to 85 per cent of inoperable cases.

If I have unduly discussed the pitfalls of surgery in cancer, it has been purely on the basis that surgery alone has not too large a field to choose from for a favorable end-result. Therefore I hope that you will bear with me if I bring up again this threadworn subject, but I feel that it is not out of line at this meeting to stress our shortcomings in cancer therapy so that we may arrive at a better understanding of cancer, and thus a better outlook and prognosis.

DISCUSSION

DR. JOHN F. HERRICK (Ottumwa, Iowa): We have listened to a paper that should bring home to us the very unsatisfactory situation in which we find ourselves placed in regard to the treatment of cancer. The essayist has discussed especially two subjects: one, the incidence of cancer. As he said, if our statistics are worth anything, cancer is increasing at a rapid rate, said to be about 2 per cent per year. He also asked the question as to whether we are advancing in our successes, whether we are gaining on cancer, and there is a doubt in his mind, evidently, a doubt in the minds of the best men treating this disease, as to whether we are getting any better results, curing any more patients, than we did some time since. The prognosis in cancer is still very, very bad. Now I have asked myself why these cancer patients die in spite of the treatment, as outlined by the essayist, the most advanced surgical and X-ray treatment, based on the judgment of men who have spent their lives studying this subject. Why is it that the prognosis is still as bad as we doctors report it? I am reminded that the mortality rate in the surgical treatment of exophthalmic goiter was originally very high. Now, since the patients are properly prepared, the operation skillfully done, and the after-treatment correct, the mortality in exophthalmic goiter has become very low. Why may not this be so in cancer?

So far as I am aware, there has been little serious, persistent, properly co-ordinated work done on cancer to determine the factors, outside of the cancer itself, that may affect the results. Volumes have been written and lives spent on study and research and experiment on cancer cells, as stated by the essayist, while little attention has been given to the hosts, the victims of the cancer. Observations tend to the conviction that cancer is more often primarily a disturbance of general nutrition—that is, the cause or the foundation is primarily a disturbance of general nutrition, first affecting the body as a whole, and secondarily affecting localized areas of tissue. So long as the body retains the fire and activity of youth, it is almost free from cancer. So long as the digestive organs and the digestive juices of the body retain the energy and the avidity of adolescence, it is almost impossible for the body cells to take on the form of cancer. Long-continued errors in diet, vitamine imbalance, overworked liver, stagnant biliary secretion, lymphatic insufficiency, constipation, toxemias, infections of the teeth and tonsils, of the gall bladder, etc., vitiate the blood stream and exhaust the defensive powers of the system. As a consequence there is hyperfunction of the thyroid, the suprarenals, but especially of those glands that secrete ferments necessary

to the proper nutrition of the cells. A man may be fat and yet the cells of his body may be badly nourished and bathed in toxic blood. Once the cancer has appeared, whatever the immediate exciting cause may be, if it is easily accessible, radical surgical treatment I still believe to be the better line of treatment; but if it has passed that stage, radiation is beyond any question the most useful form of treatment. We must not forget that it is the patient who has the cancer, and, as I believe the essayist has intimated in his paper, we must treat the patient, we must cleanse the blood, and put something of the fire and activity of youth into it. The cancer cells are running wild. They cannot do that while the body fluids are full of the active digestive ferments that maintain our nutrition. It is along this line that we may look for advance in the prevention and cure of cancer.

Dr. Samuel Brown (Cincinnati, Ohio): Dr. Sittenfield and Dr. Herrick covered the subject so thoroughly that I hardly know what I can say, except to re-emphasize some of the points. Although I am younger than the men who have spoken before me, I feel very pessimistic; I think the prognosis of cancer is bad, and the reason why it is bad is that it depends upon so many factors which are not under our control. Dr. Ewing impressed me a number of times with the fact that the disease of cancer covers many different kinds of diseases. We have different kinds of cancer. To speak of a general prognosis of cancer would be inaccurate, because it first depends on the type of cancer with which we are dealing. The second factor is the patient himself. How often does a patient harbor a cancer for a long time before he consults a physician? Naturally the prognosis would be worse in the case of that patient who allows the cancer to develop to a stage which is beyond any treatment. The next factor is the physician. How often does a physician treat a patient for dyspepsia, for instance, and waste six months or a year before he refers the case for a complete examination? Do you not think the prognosis would be better if that patient had received a thorough examination one year before, when he first noticed the symptoms? I am sure it would. Think, then, of the surgeon—there are all kinds of surgeons. Do you not think the prognosis depends also upon the skill of the surgeon? I recall patients I have examined in whom I found an operable cancer. They were operated on, and died, not from the cancer but from the operation. Now comes the roentgenologist, and although we are all good, still we differ in our experience and interpretation of the findings. I, therefore, say that, so long as we cannot control all the factors, the prognosis will be bad.

So much for Dr. Sittenfield's paper: I must differ a little with my friend Dr. Herrick. I do not deny his theory; he may be right, but I do not think he is right in saying that youth is not susceptible to cancer as much as older persons. It is true that cancer oftener occurs in older than in younger individuals, but when it does occur in younger ones it is more malignant than in older ones. Would you give the same prognosis to a patient with cancer of the breast, say, if she were a woman of twenty-five that you would if she were a woman of fifty years? I am sure we will all agree that the prognosis in a woman beyond fifty is much better than in a woman of twenty-five, although she may be in good health otherwise. I enjoyed listening to what has been said, but I think you should invite an older man to discuss such an important paper; my experience is too limited to carry a great deal of weight.

Dr. H. J. Ullmann (Santa Barbara, Calif.): Any paper, to be of value, must

stir up discussion and disagreement, and I think this paper was of such value, for it made me wish to disagree on one or two points very strongly, and therefore made me think. In the first place, I can not agree with the idea that there has been very little improvement in the treatment of cancer. First, we must consider the improvement of the technic, which is considerable, and we have still a good way to go along that line. As an example, examine the statistics for the last two or three years. The reports from Regaud's Clinic show that they are using a technic differing considerably from some of the others, and apparently are getting better results. New methods of attack are being brought out, such as the combination of chemotherapy with radiation, which undoubtedly increases the effect of radiation. Team work, which could be classed under technic in the treatment of cancer, is woefully lacking in many places. The centers having better team work give us better statistics. The best team consists of the trilogy of the surgeon, the radiologist, and the internist, working equidistant from the pathologist. These must all work together to properly treat any individual cancer patient.

There is much attention now being directed to the systemic effect of cancer. I can not agree with Dr. Herrick on that. The effect of cancer on the blood, the effect of cancer on the PH of the system as a whole, not on the tumor alone, but on the body as a whole, has been studied by Redding, and we are taking that up at Santa Barbara next year. The efforts of the Society for the Control of Cancer have had a tremendous effect. Even in our little community of Santa Barbara, I often have a patient with a non-malignant condition of the breast, such as a simple mastitis, wanting to know if it is cancer. Women come to physicians complaining of bleeding—worried to death the first time they bleed more than usual—and it gives one an opportunity to examine the uterus and see what is wrong. I believe that I am having more people come to me to-day with moles, afraid they are malignant, than actual malignancies that come in needing treatment. We are advancing, though slowly, and, above all, we must keep a hopeful attitude toward cancer or we can not get very far.

DR. SITTENFIELD (closing): I am really disappointed, because I had expected to be attacked from some quarters. So far as the increased incidence of cancer is concerned there is no doubt, from the statistics in the last fifteen years, that it has risen from 93 per 100,000 to 113 per 100,000 in New York City. The mortality statistics have experienced the same increase.

Dr. Herrick discussed the defensive factors of the patient. I think in this lies one of the most important factors to be considered in the prognosis and treatment of cancer. Somehow, the surgeon, as well as the radiotherapist, has failed to consider the defensive factors of the individual patient. To give you an idea of what I refer to, I will simply mention one factor. This can be recognized by the reparative power of the patient's blood. If, after the radiation, the blood picture returns to normal, this indicates that the patient has fairly good defensive powers. On the other hand, if the blood does not repair readily, you will realize that the individual has very poor defensive powers.

Dr. Brown's discussion of the biological significance of tumors is very important. It is only too true that in one case the tumor may persist twenty years, in another the tumor may kill in five or six months. The biological character of the tumor and its radiosensitivity are the important factors in the prognosis of cancer. Insistence on periodic examinations in persons of forty years

of age and over will do a great deal for cancer control and prognosis.

Dr. Ullmann mentions the improvement in the technic of X-ray and radium therapy within the last few years. Though the technic of radium and X-ray has greatly improved, it has not sufficed to change very materially the end-results in cancer. I admit that we are still at a very early stage in this science. A great deal more work must be done, yet it will avail little unless the radiotherapist familiarizes himself more fully with the subject of cancer in general. It is one of the points I wish to bring home to the surgeon, also. Neither one of them has realized the clinical malignancy of cancer as a disease. They deal with cancer as if it were a foreign body. The surgeon feels that his responsibility ceases when he has performed a very extensive operation and excised the tumor; he is apt to think that he has done his duty, and therefore interest in the patient lags. The radiotherapist, I am sorry to say, has taken a similar attitude. He radiates the field of operation or the adjacent regions, and contents himself with this local radiation. Neither one has made a really serious attempt to familiarize himself with the study of cancer as a disease. The knowledge of what cancer really is, how it spreads, its clinical and biological malignancy makes cancer a special study. These are the salient points I wish to bring before you.

CASE REPORT

A CASE OF THORACIC STOMACH

By HUGH MORRIS, M.D., D.M.R.E.

Radiologist, Royal Manchester Children's Hospital and Salford Royal Hospital, MANCHESTER, ENGLAND

Three cases in which the stomach has been found lying above the diaphragm during an X-ray examination have been recorded, two by LeWald (2, 3) and one by Roberts (4). A fourth case has been described by Bailey (1), but this was a postmortem discovery. I wish to add a fourth case to those which have been discovered by roentgenologic means.

The patient, a female aged 44, was referred to me for X-ray examination by Dr. Langley, honorary physician to the Salford Royal Hospital. Until about a year before this time she had always enjoyed good health, except for an injury to her right arm which had necessitated its removal above the middle of the humerus. During the past year she had suffered from vague indigestion which had no relation to food. She had also lost a considerable amount of weight. Weight at the time of examination was 109 pounds, and she stated that her usual weight for years had been 140 pounds. Appetite was poor and the diet for several months had consisted only of milk. There was no nausea and no vomiting. The bowels were regular. Inspection, palpation, and percussion of the chest and abdomen failed to reveal anything of an unusual nature. In view of her age and the history, a clinical diagnosis of cancer of the stomach was suggested.

X-ray Findings.—The stomach was found to lie above the diaphragm and mainly on the right side. The esophagus followed its normal course as far as it went, but it was shorter than usual, resembling in this respect the cases previously described. The pylorus corresponded with the opening in the diaphragm and the duodenum was in the abdominal cavity. The stomach rapidly

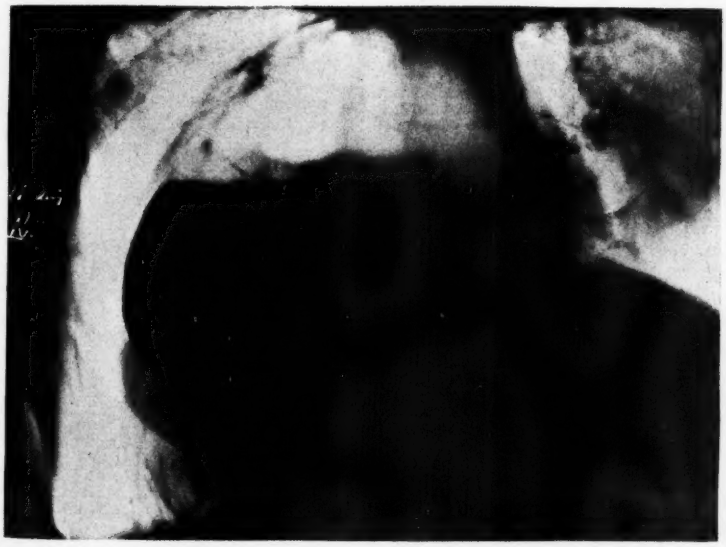

Fig. 1. Antero-posterior view of the stomach, the patient standing.

Fig. 2. Lateral view of the stomach, the patient standing.

emptied itself and showed no barium content ninety minutes after the ingestion of a fluid opaque meal. The position of the stomach is best seen by reference to the illustrations, which show antero-posterior (Fig. 1) and lateral (Fig. 2) views of the stomach with the patient standing.

Re-examination of the stomach after an interval of ten months showed exactly the same state of affairs as when the first examination was made. Her weight at the time of the second examination was 105 pounds. At first it was thought that there might possibly be a lesion in the stomach to account for the loss of weight and the indigestion, but this now seems unlikely. The patient is being kept under observation and future developments, if any, will be watched with interest.

REFERENCES

(1) Bailey, P.: Anat. Rec., 1923, XVII, 107-109.
(2) LeWald, L. T.: Radiology, 1924, III, 91-104.
(3) LeWald, L. T.: Am. Jour. Roentgenol. and Rad. Ther., November, 1928, XX, 423-430.
(4) Roberts, R. E.: Brit. Jour. Radiol., 1927, XXXII, 17-19.

EDITORIAL

THE X-RAY AS A DIAGNOSTIC AND THERAPEUTIC AGENT

It is remarkable how people to-day recognize the importance of an X-ray examination if there is any pain or swelling in the region of a bone or joint. They were brought to this largely by the simplicity of the idea of the necessity of an X-ray film when a bone is broken. It required some years, however, to impress the medical profession and the people with the same necessity of taking an immediate X-ray film after a slight injury to a bone, called "contusion" or "bump," or a trauma to a joint called a "sprain." Non-medical persons, especially parents, have gone farther in their intellectual conception. When one of their children has a pain or a limp or a swelling, they demand an X-ray examination first. The majority of persons to-day are not content with the diagnosis of "growing pains," "charlie horses," "bumps," sprained ligament, torn muscle, or the most dangerous diagnosis, "rheumatism." They demand an X-ray examination. This has already, since 1920, increased the cures of cancer (sarcoma) of bone from less than 4 per cent to more than 30 per cent. So ignorant were the people of the value of an X-ray diagnosis that no child or adult was cured of a sarcoma of bone in the Johns Hopkins Clinic until 1913. By 1921 we had cured but 4 per cent; by 1929, 30 per cent. Education and the X-ray accomplished this.

The early examination of a bone or joint has tremendously reduced the crippling of children. The new knowledge of essential foods, milk, cod liver oil, fruit juices, green vegetables, and sunlight has wiped out rickets, with its deformity of bones. How fortunate for the female of the race that bowlegs and knock-knees and bending tibias and deformed ankles were prevented before the age of short skirts! The crippling due to tuberculosis of joints has been largely wiped out by better and pasteurized milk; osteomyelitis of bone by cleaner milk and water and the earlier removal of tonsils and adenoids in children, and the better care of the teeth, and the wiping out of typhoid fever. And the earlier application of the X-ray has increased the cures of cancer of bone and reveals the non-cancerous tumors of bone so early that they can be cured without crippling. This progress in the earlier recognition of diseases of bone and in the prevention of many of the diseases of bones and joints must be looked upon as a remarkable achievement since 1900, as great an achievement as the wireless and the flying machine.

The medical and dental professions and the people have not grasped the protective value of X-ray films of the teeth as they have X-ray films of the bones or joints. I think it may be safely said that the most neglected focus of infection which is dangerous to both child and adult, is a root abscess. X-ray films of the teeth should be made periodically—one should not wait for symptoms, especially when the gums begin to recede and there are many fillings or much

bridgework. I am inclined to the opinion that periodic examinations are as valuable as life insurance, perhaps more so. Life insurance would increase in value if its first examination was more thorough and it insisted upon annual examinations as well as on premium payments.

The public and the medical profession have failed chiefly in recognizing the protection of an X-ray study of the stomach the moment there are any warning symptoms from within the abdomen. The operation for cancer of the stomach (resection) was marvelously planned and executed in 1884 by Billroth, a surgeon in Vienna. In spite of this, in the Johns Hopkins Clinic from 1890 to 1915 the actual percentage of cures of cancer of the stomach was less than two, which was 10 per cent of those cases in which the operation could be performed. In 90 per cent of the cases the individual came into the clinic in a hopeless stage of cancer of the stomach. In spite of the wonderful diagnostic value of the fluoroscope and X-ray film in diseases of the stomach, the percentage of inoperability in 1928, in all great clinics of the world, has been reduced only from 90 to 60 per cent, and the permanent cures after resection have been increased from 10 to 30 per cent.

Most persons to-day, if they think they have heart disease, go to their doctor and say: "Please listen to my heart." But very few who have indigestion or any unusual symptoms from the abdomen, go to their doctor and request an X-ray examination of the stomach. X-ray study has a wider application in the recognition of organic disease than any other diagnostic test. Improvement can be made only through its earlier application.

There is room for one other important statement in regard to the X-ray. This and radium are valuable therapeutic agents in treating tumors and malignant disease. Everyone knows what a "lump" is. Human beings usually feel a lump when it is smaller than a bean. Unless properly informed they pay no attention to a lump unless it grows rapidly or gives pain. Every individual who feels a lump, no matter where the lump may be, or whether he feels one or more lumps, should seek examination by a physician at once. The medical profession is now learning that if the lump is growing rapidly, it should be removed at once, unless it is situated near a great nerve or vessel. Then, before removing the lump, it should be treated with X-ray or radium radiation. A certain number of lumps are radiosensitive and growth in them can be prevented by radiation. Thousands of lives can be saved by instructing the public to seek an examination the moment they feel a lump and by teaching the medical profession throughout the country the best method of diagnosis and treatment.

Practically every locality in the United States has a modern X-ray apparatus and one trained in its use within easy walking, automobile, or railroad journey. A like uniform distribution of adequate amounts of radium has not yet been accomplished, although there is sufficient radium in the world to make such a distribution possible. It is my opinion that this progressive movement is near at hand, and every locality will have available everything that is necessary for the recognition and treatment of cancer in all stages. The medical and dental professions recognize that they must prepare themselves for the demands of an enlightened public, and the public in this country is amply able in its prosperity to finance its health protection just as well as its protection from fire.

JOSEPH COLT BLOODGOOD, M.D.

Injections of glucose have been found to be beneficial in acute cases of encephalitis, the European sleeping sickness.—*Science Service.*

THE X-RAY FILM HAZARD

That there is a hazard in the handling and storage of cellulose nitrate X-ray films has been recognized for a number of years. That the consideration of this hazard becomes a most pertinent matter in the case of hospitals and similar institutions is something that has caused hospital executives and roentgenologists considerable thought.

The dangers involved in handling the storage of these films has been exhaustively considered by prominent fire authorities and engineers ever since the war. In 1925 the National Fire Protection Association published a booklet of regulations which was adopted by the National Board of Fire Underwriters. It has been the consensus of opinion of authorities that these regulations, if rigorously carried out, take care of the fire hazard and the gas hazard in the case of cellulose nitrate X-ray films. A number of institutions have patterned their film storage after these regulations. It is, however, not always an easy matter to achieve the ideal, and the obtaining of space for structural changes, and possibly increased personnel, has been somewhat difficult.

It is the belief of those who have given serious study to the problem that it is only by the adoption of what is known as Safety X-ray Film that the problem is completely solved. Undoubtedly, there are in many places accumulations of a great many films on cellulose nitrate base that it is felt necessary to keep, so that even if Safety Films are adopted, there are, in many cases, storage problems. It can only be urged most emphatically that these storage arrangements should conform with the best practice recommended by fire engineers. Furthermore, the necessary thing in such storage conditions is to see that they are always maintained with maximum efficiency; for, of course, a false sense of security is worse than none at all.

Safety Films are made with cellulose acetate base or support. A brief discussion of the combustion characteristics of cellulose nitrate and cellulose acetate base will serve to emphasize why the nitrate base is dangerous, and the acetate base may be stored the same as paper records.

The following gases have been found to be liberated when cellulose nitrate films are decomposed: Carbon monoxide; carbon dioxide, and the following oxides of nitrogen—nitric oxide (NO), nitrogen dioxide (NO_2), and nitrous oxide (N_2O). Camphor vapors and complex tarry residues also are given off. These two latter products of decomposition are relatively of no importance from a toxicity standpoint. Carbon monoxide is colorless, odorless, and poisonous, causing death almost immediately. The action of this gas is well known because of its presence at almost all fires and the many closed garage fatalities.

Nitric oxide is colorless and nitrogen dioxide is a deep reddish brown. When inhaled, these gases give nitrous (HNO_2) and nitric (HNO_3) acids by combination with moisture in the lungs. If these gases are inhaled in sufficient quantities, death may ensue after an elapsed period of hours or days.

When cellulose nitrate films are allowed to burn freely in an excess of air, the following gases are liberated: Carbon dioxide, nitrogen, and probably nitrous oxide. All of these gases are non-poisonous but may, of course, cause suffocation by cutting off the oxygen supply for breathing.

There is no parallel to be drawn between the burning of cellulose nitrate and cellulose acetate films, the two behaving in entirely different manners.

When cellulose acetate films are burned with an abundance of air, carbon dioxide and water are the sole products of combustion, exactly the same as when paper is burned.

When the cellulose acetate films are subjected to high temperatures due to an external fire, and if the supply of air is very limited, what is known as destructive distillation takes place and two gases, carbon monoxide and carbon dioxide, are evolved, and acetic acid vapors are produced in the same manner as when paper is heated under similar conditions.

RESOLUTIONS

WHEREAS, the storage and preservation of used X-ray films has recently become an economic and insurance problem, and

WHEREAS, the reports of the roentgenologists responsible for the diagnoses are of decidedly more value and importance than the films, and

WHEREAS, these reports are filed with, and become a part of, the records of each case, making it unnecessary that large numbers and quantities of old and used X-ray films be preserved and retained for long periods of time, it is therefore

RESOLVED, by the Council of the Chicago Roentgen Society, acting officially for the Chicago Roentgen Society, that it is the sense and judgment of this Society, that it is not necessary to preserve any X-ray films for a longer period than two years after their exposure, and that in all cases where there is no likelihood of legal proceedings—such as ordinary clinical cases, medical conditions, gastro-intestinal and urinary tract examinations—it is deemed unnecessary to preserve or retain the X-ray films for a longer period than six months after their exposure.

This is, however, not in any way to be construed as discouraging the preservation of films of specially interesting or unusual conditions, as these are to be preserved because of their value for comparative study and for teaching purposes. And it is further

RESOLVED, that referring physicians desiring to preserve the X-ray films of their own patients, be encouraged to do this, and it is hereby declared permissible and proper practice for roentgenologists to deliver the films to the referring physicians in such cases. And it is further

RESOLVED, that a copy of these Resolutions be sent to the *Bulletin of the Chicago Medical Society*, the *Illinois Medical Journal*, the *Journal of the American Medical Association*, RADIOLOGY, and the *American Journal of Roentgenology and Radium Therapy*, for publication, and to the American College of Radiology, the American College of Surgeons, and the American College of Physicians with request that the same be published in their official journals, and to the Sections on Radiology of the American Medical Association and of the Illinois State Medical Society, and to the Chief of the Fire Prevention Bureau of Chicago and the Underwriters' Laboratories, Inc., of Chicago, and to the editors of *Hospital Management* and *The Modern Hospital*.

NEW ENGLAND ROENTGEN RAY SOCIETY

At the annual meeting of the New England Roentgen Ray Society, Dr. John H. Lambert, of Lowell, was elected President for the ensuing year, Dr. A. S. MacMillan, of Boston, Vice-president, and Dr. Thomas R. Healey, of 370 Marlboro Street, Boston Secretary and Treasurer. The retiring President, Dr. Frank W. Lamb, of Portland, Maine, was added to the Executive Committee.

AMERICAN COLLEGE OF RADIOLOGY

The Convocation of the College took place July 10, at the Hotel Multnomah, Portland, with a good attendance. The Presidential Address was delivered by Dr. Alfred L. Gray, of Richmond, Virginia. Dr. James T. Case, of Chicago, was inducted into the office of President for the ensuing year, and Dr. Rollin H. Stevens, of Detroit, was chosen President-elect. Dr. Fred M. Hodges, of Richmond, Virginia, Dr. Ernst A. Pohle, of Madison, Wisconsin, and Dr. Charles W. Prowd, of Vancouver, B. C., Canada, were elected to Fellowship.

SECTION ON RADIOLOGY

AMERICAN MEDICAL ASSOCIATION, PORTLAND, JULY, 1929

The meetings of the Section were well attended. The officers chosen for the coming year are: Dr. Fred M. Hodges, of Richmond, Virginia, *Chairman;* Dr. William B. Bowman, of Los Angeles, *Vice-chairman;* Dr. George W. Grier, of Pittsburgh, *Secretary.*

AWARDS IN THE SCIENTIFIC EXHIBIT

AMERICAN MEDICAL ASSOCIATION, PORTLAND, JULY, 1929

It is of interest to all radiologists that, out of fifteen scientific awards, eight were in some way related to roentgenology.

Awards in Class I are made for exhibits of individual investigations which are judged on the basis of originality and excellence of presentation. The Gold Medal in this class was awarded to Dr. Eugene P. Pendergrass and Dr. Temple Fay, of Philadelphia, for the originality and thoroughness of their contribution to encephalography and the excellence of the presentation. A Certificate of Merit was given to the exhibit of Dr. Eben J. Carey, of Milwaukee, illustrating a continuation of the experimental studies of bone growth, for which he received the Silver Medal last year. A Certificate of Merit was awarded to the exhibit of Dr. Arthur W. Erskine, of Cedar Rapids, Iowa, on roentgen therapy technic.

Awards in Class II are made for exhibits which do not exemplify purely experimental studies, and which are judged on the basis of the excellence of correlating facts and excellence of presentation. A Certificate of Merit was bestowed upon the joint exhibit of Dr. C. C. McCoy, Dr. H. J. Gerstenberger, Dr. L. P. Harsh, and Dr. D. G. Shields, of Cleveland, for their study of bone disorders in childhood. The exhibit of Dr. Charles G. Sutherland, of Rochester, Minnesota, showing roentgenograms of bone lesions, was deemed worthy of special mention.

THE TORONTO MEETING

THE COMMERCIAL EXHIBIT

A recent visit to Toronto and inspection of the facilities available at the magnificent new Royal York Hotel, disclose a most gratifying situation. Both Dr. Hubeny and the writer, upon carefully looking over the "convention floor" in this hotel, are agreed that *nowhere* and *at no time* have we seen the equal in physical arrangements that go toward making a successful meeting.

The banquet hall is the largest room on this "convention floor," being 64 feet wide by 160 feet long and two stories high. The walls are supplied with ample electrical outlets. Numerous passenger and a good freight elevator are near at hand. It was tentatively planned with the Local Committee in Toronto, that the commercial exhib-

The Royal York Hotel, Toronto, scene of the next Annual Meeting, Dec. 2–6, inclusive.

its are to be arranged *around the walls* in the banquet hall and the scientific exhibits are to be placed *in the middle of the same room*. It is obvious that this arrangement will bring much more than the usual amount of attention to the commercial exhibits, and make this important accessory to our meetings much more attractive and desirable to the manufacturers and dealers who have done so much toward the success of our meetings.

At the other end of the magnificent "grand foyer" is situated the concert hall, where the principal sessions of the meeting will be held, while between these two large rooms are several smaller ones suitable for section meetings, clinics, etc.

The desirability of exhibiting at this meeting can scarcely be overestimated. This will be the first Annual Meeting of the Radiological Society ever held east of Cleveland, Ohio, and will bring out a larger number of radiologists and visitors from the eastern portion of this country and of Canada than has any previous meeting—at least, since the 1925 Summer Meeting in Atlantic City. We expect to have not less than 250 from New England who have never attended any of our meetings. The railroads have launched extensive advertising campaigns which are bound to swell the attendance, and it would not be surprising to find the enrollment at Toronto in excess of all except the recent Chicago meeting.

The rates for exhibit space will be the usual fair and equitable low prices, depending largely upon location and desirability. There will be plenty of space for all, unless demands exceed what is expected.

Blueprints, rates, and literature regarding the commercial exhibit will be sent to those on our regular mailing list the latter part of September, and it is anticipated that the bulk of the space will be sold within two days after the blueprints are in the exhibitors' hands.

Manufacturers and dealers anticipating making an exhibit are urged to read the item in the May, 1929, issue of RADIOLOGY, page 451, entitled "Commercial Exhibitors, Attention!" Particulars relative to Customs regulations are there given.

All interested manufacturers, jobbers, and dealers who are not regularly on our mailing list are invited to write the undersigned, requesting the literature regarding the commercial exhibit at the Toronto meeting. Those who are unacquainted with our methods will do well to inquire from firms who have exhibited with us in the past.

The meeting will be held December 2 to 6, inclusive, 1929, at the Royal York Hotel (the largest hotel and the highest building in the British Empire), Toronto, Canada.

I. S. TROSTLER, M.D.
Mgr. Commercial Exhibit and Transportation for the Society.
812 Marshall Field Annex, Chicago.

THE FIFTEENTH ANNUAL MEETING

Next December will mark a notable event in the history of the Radiological Society of North America, for then it holds its first annual meeting outside the United States. The place of meeting will be in the City of Toronto, Canada, and we are confident that all who attend will be thoroughly satisfied with the choice. Accommodation promises to be of the very finest, and the various committees are already hard at work to make this meeting the most successful yet held.

Toronto, the capital of Canada's richest province, Ontario, is a progressive city and may be trusted to prove a pleasant surprise to those who have never visited it. It is beautifully situated on the north shore of Lake Ontario behind a large natural harbor, where remarkable developments are taking place which have already given it one of the finest waterfronts to be found on the Great Lakes. The city has a population of over 700,000 and covers an area of approximately thirty-six square miles. It is unusually well built, and, in addition to fine public buildings and numerous skyscrapers, possesses extensive residential districts of great beauty.

The meeting will be held in the Royal York Hotel, a magnificent structure built by the Canadian Pacific Railway, and just completed this year. An entire floor, specially designed to accommodate large gatherings, will be available for our meetings, the largest of the halls being capable of seating more than 1,700 persons.

It is appropriate that Toronto should be chosen for our first meeting in Canada in that its name, derived from the Indian, means a "place of meeting." Starting as a small trading post of the early French *voyageurs*, it has grown to be a great commercial city and a favorite center for conventions, thanks to its many attractions and its great accessibility. It is only an overnight journey from New York, Washington, or Chicago, and can be easily reached by good motor roads *via* Buffalo, Niagara Falls, or Detroit. As the Royal York Hotel is directly opposite the Union Station, you can be at the place of meeting within a few minutes after leaving the train.

As an educational center Toronto has always held a position of prominence, and its University is now one of the largest in the British Empire. The undergraduate teaching of its Faculty of Medicine has been notable for its thoroughness, from the days when Osler learned the rudiments of medicine there until the present day, while in recent years it has taken a leading position in research work. It will be remembered that it was there that Banting and his associates discovered insulin in 1921.

The city possesses a number of fine modern hospitals, the largest of which is the Toronto General Hospital, with more than a thousand beds. St. Michael's Hospital and the Toronto Western Hospital are also well worth visiting, and the Hospital for Sick Children is one of the most complete institutions of its kind.

The Royal Ontario Museum of Archæology and Zoology is a vast treasure-house containing, among other things, a unique collection of prehistoric mammals, which should not be missed, while the Academy of Medicine houses an extensive library in which the lover of old books will find some early medical works of great rarity.

Perhaps it is as well for the success of the meeting that it is to be held at a season when Toronto's out-of-doors attractions are not at their maximum; otherwise the attendance at the sessions would undoubtedly suffer. With twenty-five golf courses, three large race-tracks, numerous ball-grounds, football fields, canoeing, sailing and rowing clubs, and three great hockey

arenas, the city is well equipped for devotees of sports, and its great Annual Exhibition in early September and the Royal Winter Fair and Horse Show in November attract visitors from all parts.

Lastly, you will find Toronto a very friendly city and sufficiently American to make you feel thoroughly at home. You are, therefore, urged not to miss what promises to be a most interesting meeting. Make your plans now and watch for further announcements in RADIOLOGY. The dates are Monday, Dec. 2, to Friday, Dec. 6, inclusive.

A. H. ROLPH, M.D.
Chairman, Publicity Committee.

WARNING AS TO FIRE EXTINGUISHERS

The use of small hand-pump extinguishers on film fires may result in the formation of phosgene ($CO\ Cl_2$) in poisonous quantities. The danger seems to be due to carbon tetrachloride, which, in contact with heated iron or metals, or with an actual fire, produces phosgene. This has been confirmed experimentally, and the details may be found in an article by Fieldher, Katz, Kinney, and Longfellow in the *Journal of the Franklin Institute*, 1920, CXC, 543. These men report several fatal accidents from the use of carbon tetrachloride extinguishers in small rooms, and a non-fatal one in the open where an automobile fan drove the products of combustion into the patient's face.

This applies only to the small hand-pump type of fire extinguisher containing carbon tetrachloride. The carbon dioxide type is apparently quite safe, but the best and quickest results have been obtained experimentally by automatic sprinklers.

SHOCK-PROOF X-RAY APPARATUS

One of the manufacturers has recently announced the development of an X-ray apparatus so designed that it is 100 per cent electrically safe; that is to say, proof against any possibility of shock to either operator or patient from the high voltage system.

By immersing both the X-ray tube and the high tension transformer in oil, and sealing in the same container, there has been complete elimination of the usual high voltage conductors between these two units. One may be in actual contact with any part of the apparatus during an exposure, without danger of electrical shock.

Every improvement that tends to reduce the hazards of roentgenology is most welcome. It marks progress in the art and offers further proof that the manufacturer has a not altogether selfish interest in those problems, the solution of which demands adequate facilities for research and experimental engineering.

X-RAYS IN INDUSTRY

X-ray photography is practically identical in the public mind with certain phases of medical and dental science, but such a valuable tool would not readily confine itself to the needs of the anatomical sciences in this day of alertness to new uses for existing processes. X-rays are increasingly being used to determine the internal structure of inanimate objects.

Steel castings, aluminum castings, metal radio transmission tubes, a variety of other metal objects, and even trees and telegraph poles, have been subjected to X-ray examination, such examination having already become standard practice in some factories. The principal work along these lines has

been done in the Watertown Arsenal and the Massachusetts Institute of Technology, in the United States, and in the Woolwich Arsenal, in England.

This information, as part of a brief survey of the theory and use of X-rays in industry, is included in a booklet just prepared by the Eastman Kodak Company entitled "X-rays in Industry." The publication, which will be sent to interested persons, has the intention of suggesting some of the industrial applications of X-rays in inspecting the internal construction of opaque materials.

This booklet should stimulate manufacturers to visualize many applications of radiography peculiar to their own businesses.

MERGER OF TWO COMPANIES

The merger of the Acme-International X-ray Co., of Chicago, and the Engeln Electric Co., of Cleveland, to be known as the American X-ray Corporation, has just been announced, effective July 1, 1929. Both of these companies have for many years played conspicuous rôles in the development of X-ray and physical therapy apparatus, and have won a vast number of friends in the medical profession throughout the country.

The extensive lines of both companies will be retained essentially unchanged, and a wide distributing organization covering the United States and many foreign countries will be maintained to service the products and give the closest personal attention to the requirements of the medical profession.

This concentration, bringing together greatly increased facilities for production, research, experimental and educational activities, should prove of striking benefit to the profession, which is now offered an exceptionally wide line from which to choose suitable equipment, and is assured of excellent service facilities in any part of the country.

Leonard A. Busby, President of the Chicago City Railways, was elected President of the American X-ray Corp., a very good index of the financial strength and the sound business policies which characterize this new organization. The officials who have in the past guided the two companies to a position of leadership in the industry, remain actively in charge of its management: H. P. Engeln, First Vice-president in Charge of Sales; Frank L. Severance, Vice-president and General Manager, and Montford Morrison, Vice-president and Chief Engineer.

THE UNITED STATES VETERANS' BUREAU NEEDS PHYSICIANS

Anticipating the need of physicians for the future, the U. S. Veterans' Bureau proposes placing on duty at its several hospitals throughout the United States thirty additional physicians as soon as they can be secured. These physicians must meet the requirements of the Civil Service Commission as to training and experience; in general, it may be stated that they must have graduated from a Class A Medical School within five years of date of application and, in addition, must have had at least one year's internship in a general hospital.

Physicians who have had training and experience in such specialties as neuropsychiatry, operative surgery, eye, ear, nose, and throat diseases, and clinical pathology, are particularly urged to forward their applications to the U. S. Civil Service Commission, 1724 F Street N. W., Washington, D. C., and request that the necessary forms be sent them for execution.

The Medical Service of the Bureau offers a diversified and interesting service for

physicians, with opportunities for research, post-graduate training, etc. The entrance salary is $3,200 per annum, and, if the service of the medical officer is satisfactory, he may be promoted in increments of $200 per annum, and, upon the completion of three years' satisfactory service, he will be automatically promoted to the next higher grade at the minimum salary of that grade —$3,800 per annum.

BOOK REVIEW

ULTRA-VIOLET RADIATION. By ELEANOR H. RUSSELL, M.D., and W. KERR RUSSELL, M.D., with Forewords by SIR OLIVER LODGE, F.R.S., D.Sc., LL.D., and SYDNEY WALTON, C.B.E., M.A., B.Litt. New York, William Wood and Company. Edinburgh, E. and S. Livingstone. Cloth. Price, $5.85 net. Pp. 648, with 259 illustrations.

This book is evidently designed as a guide in ultra-violet therapy for physicians in general practice. The conception of the work and its divisions are excellent. The chapters devoted to the physical aspects of ultra-violet rays and to the construction of ultra-violet generators are on the whole satisfactory, but the work is not sufficiently critical and does not offer sufficient help in the selection of different types of generators. The chapters on the biological effects of ultra-violet rays and on pathology do not cover the subject thoroughly and give only a superficial idea of the experimental background of the subject, especially with reference to the mechanism by which ultra-violet rays act on the tissues. The chapter on technic and on the arrangement of facilities for ultra-violet irradiation is perhaps the best in the book. The last five chapters are devoted to a discussion of the therapeutic value of ultra-violet rays in various diseases. While much of this discussion is sound, some of it is rather sketchy and there emanates from it an impression of uncritical acceptance of many claims, some of which rest on doubtful evidence. Much is made of the fall in blood pressure which is said to follow ultra-violet irradiation, but the explanations advanced do not include the rest incident to irradiation. Statements made by patients are too often submitted as evidence of the value of ultra-violet irradiation, or claims are made on the basis of a single case, such as in Raynaud's disease and other conditions, in which the value of ultra-violet irradiation is doubtful, including epilepsy, whooping cough, gastric ulcer, and hemorrhoids. On the whole, this book is a useful addition to the literature, but its value is diminished by its apostolic tone.

ABSTRACTS OF CURRENT LITERATURE

INDEX TO ABSTRACTS IN THIS ISSUE

On Radiation Therapy of Diabetes. Erwin Kolta. Strahlentherapie, 1929, XXXI, 797.

Stephan observed improvement in diabetic patients following X-ray therapy to the pancreas. The author gave this method a trial in a number of cases, but without any beneficial results (filtered radiation, 25 per cent H.E.D. per field, one anterior and two posterior). Some patients grew temporarily worse after the treatment.

E. A. POHLE, M.D., PH.D.

Notes on the X-ray Diagnosis of Mitral Stenosis. Harold Cookson. Lancet, June 29, 1929, CCXVI, 1344-47.

The author gives his results following a clinical and roentgenological study of a series of mitral stenoses. Of forty cases in which the diagnosis was definitely mitral stenosis he was able to find a typical roentgen picture in 72.5 per cent. In 10 per cent the roentgen examination failed to show any changes typical of this condition. Three per cent showed only a prominent pulmonary artery. The author describes the convex prominence in the left middle arc as being due chiefly to the prominence of the pulmonary artery and partly to an increase in the size of the conus arteriosus and the left auricular appendix. His roentgen examination consisted of orthodiagram, anterior posterior projection on film and a film made in the right anterior oblique position. He believes this position to be the most favorable in showing encroachment and partial obliteration of the retro-cardiac space by the backward dilatation of the left auricle. A prominent pulmonary artery is met in any condition which leads to right ventricular hypertrophy, and enlargement of the left auricle is also met with in association with rheumatic hearts not presenting a mitral stenostic picture. The author believes it rare, however, apart from rheumatic heart disease, and also states that mitral incompetence is rare apart from stenosis. He concludes by stating that the roentgen picture of the heart in mitral stenosis, while not infallible, is of great value in the diagnosis.

M. J. GEYMAN, M.D.

The "Massive" and "Hypermassive" Radiation in the Treatment of Skin Cancers. William A. Evans and T. Leucutia. Brit. Jour. Radiol., November, 1928, I, n. s., p. 396.

After passing through eras of "burns," fractional methods, and combined methods, the roentgen treatment of skin cancers now rests firmly on the "massive treatment" basis. For

classification in outlining treatment all skin cancers are grouped as (1) small superficial nodular or ulcerated lesions; (2) medium ulcerous nodular lesions; (3) fungous lesions; (4) large superficial ulcerated lesions, or (5) large deep-seated lesions. The "massive dose" is the amount of roentgen radiation necessary to produce a good erythema in normal skin and represents 100 to 200 per cent of a skin unit dose. Several skin unit doses represent a hypermassive dose. Cancers in the first group are treated by massive doses of unfiltered rays, while the more extensive and more deeply seated lesions are treated with penetrating, heavily filtered rays, combined with unfiltered rays, and the fungous lesions are first electrocoagulated and then given massive unfiltered X-rays.

A number of illustrated case reports are presented showing the response of early and advanced cases, both untreated and when various other methods of treatment had failed to give a permanent result.

J. E. HABBE, M.D.

Results in the Treatment of Cancer and the Relations of Age to Number of Cures and Required Radiation Dose. F. Seisser and W. Mau. Strahlentherapie, 1928, XXVII, 663.

Remarks Regarding the Previously Published Paper. A. Bauereisen. Strahlentherapie, 1928, XXVII, 691.

The first paper is a statistical review based on 652 carcinoma cases of the Women's Clinic at Magdeburg-Sudenburg during the period from January 1, 1915, to April 1, 1924. In carcinoma of the cervix 21.6 per cent were cured (over 5 years), 9.8 per cent by operation and 11.8 per cent by radiation therapy. The corresponding figures for carcinoma of the fundus are 52.5 per cent (total), 30 per cent (operation), and 22.5 per cent (radiation); for carcinoma of the ovary 20.7 per cent (total), 11.3 per cent (operation), and 9.4 per cent (radiation). Every operable case of carcinoma of the cervix was operated on and irradiated, with a relative cure of 61.9 per cent. Radiation alone in operable cases gave a relative cure of 43.4 per cent, while the same procedure in inoperable and borderline cases resulted in a relative cure of 15.6 per cent. The primary mortality of Wertheim's operation amounted to 5.7 per cent. It appeared that an overwhelming number of the patients were married and the frequency of carcinoma increased with the number of pregnancies (except in cases of carcinoma of the ovary). The prognosis, both following operation and irradiation, improved with increasing age. Between the ages of 40 and 50, the period during which the majority of patients were seen, the operation for carcinoma of the cervix led to less favorable results than the irradiation alone of operable cases.

It was impossible to make definite deductions regarding the relation between the histology of carcinoma and prognosis and radiosensitivity. Treatment with mesothorium alone gave just as good results as combined treatment with mesothorium and roentgen rays. Intensive curettage of carcinoma of the cervix before irradiation did not impair the prognosis, but increased the danger of fistulæ formation. The operative results were definitely improved by post-operative X-ray therapy. The authors regard an average curative dose effective in the diseased cervix to be about 200 per cent of the erythema dose (1 E.D. equal to 600 *R* in air). There existed a relation between curative dose and age. This dropped from 275 per cent E.D. at 30 years to 175 per cent E.D. at 70 years. The average dose for carcinoma of the fundus amounted to 120 per cent E.D.

Bauereisen emphasizes in the brief comment on the previous article the importance of using the right dose in irradiating carcinoma. Too small and too large doses are harmful. Nation-wide education of the public and co-operation of the welfare organizations are essential in the combat against cancer.

E. A. POHLE, M.D.

Dyschondroplasia: Multiple Cartilaginous Exostoses, with Reports of Two Cases. Samuel W. Boorstein and Henry Hirsch. Am. Jour. Surg., February, 1929, VI, 194.

This condition is known by various names, some of the more common being (1) multiple cartilaginous exostoses, (2) hereditary deforming chondrodysplasia, and (3) multiple cancellous exostoses.

The authors give an extensive classification of this lesion, according to stock. It is usually of hereditary origin. The pathology consists of a disturbance of the processes of proliferation and ossification of the epiphyseal cartilage during the period of skeletal growth which is retarded. Microscopically the resemblance to chondroma is striking.

Roentgenologically they describe a general thickening and enlargement of the end of the shaft, and exostoses arising from uncovered areas, or "islands," of enchondral bone. These usually occur near the ends of the shaft, but may become detached from the growth disc in the early stages of growth, and are sometimes found near the middle of the shaft.

H. P. Doub, M.D.

Gastro-esophageal Carcinoma: Its Diagnosis. Louis J. Notkin. Can. Med. Assn. Jour., July, 1928, XIX, 96.

The diagnosis of this condition is difficult and requires special methods of X-ray procedure. The patient should first be fluoroscoped and radiographed in the upright left oblique position. Then the horizontal position is used. If these methods fail, the Stuertz position should be used. The stomach is filled with gas, and the patient fluoroscoped in an oblique position, the rays being directed from the right, posteriorly and above, to the left anteriorly and below.

The direct signs of cancer of the esophageal cardiac area are: (1) A tumor shadow bulging into the gas bubble; (2) irregularity of the barium contour as it passes through the cardia; (3) splitting of the barium stream as it enters the stomach.

The indirect signs are: (1) Spasm of the esophagus or cardia; (2) disturbance of the cardial mechanism, as a trickling of the barium through the cardia; (3) absence of the gas bubble; (4) shrinking of the stomach; (5) drawing of the stomach upwards and to the left; (6) increased distance between the upper pole of the stomach and the diaphragm; (7) narrowing of the fundus; (8) obliteration of the triangular space formed where the esophagus turns forward and to the left, to enter the diaphragm.

L. J. Carter, M.D.

Does the Secondary Infection of the Uterine Carcinoma Influence the Results of Radiation Therapy? Hans Dehler. Strahlentherapie, 1929, XXXI, 691.

Dehler asserts that the secondary infection of the uterine carcinoma plays an important rôle in the successful treatment of that disease. The results are almost proportional to the virulence of the bacteria in the cervix and uterus. He advises the carrying out of a bacteriologic examination before giving radiation therapy, particularly intra-uterine radium application. General treatment to increase the resistance and improve the blood should be instituted first. Sometimes serotherapy may be helpful in overcoming the infection. Not too much time must be lost, however, with this preliminary treatment. X-ray therapy should be started as soon as possible. The antiseptic effect of roentgen rays in uterine carcinoma has been established; of the same importance is a thorough after-care.

E. A. Pohle, M.D., Ph.D.

Metrosalpingography with the Aid of Iodized Oil. I. C. Rubin and A. J. Bendick. Am. Jour. Roentgenol. and Rad. Ther., April, 1928, XIX, 348.

The shape, dimensions, position, and appearance of the lipiodol-filled uterus and fallopian tubes are described clearly. Only such cases are injected as show obstruction under roent-

genoscopic control, so that the procedure may be stopped immediately upon the entrance of any of the opaque oil into the peritoneal cavity. Peristalsis is observed only in the ampullary portion of the tube and apparently progresses in both directions. The uterus usually empties itself within ten minutes, apparently by contracting as a whole rather than by peristaltic activity. The normal tube empties within several hours, but in the presence of a dilated ampulla and obstructed fimbria the oil may remain for months or years. The lipiodol which enters the peritoneal cavity is slowly emulsified and probably absorbed.

The procedure is of greatest use in the examination of sterile women, to accurately localize the site of obstruction or stenosis and to assist in determining the surgical procedure indicated. The test is also of value for intrauterine tumors, such as fibroids and polyps. While the procedure is almost diagnostic in early pregnancy the danger of inducing abortion is too great to warrant recommending it as a routine examination. Both the writers and one of the discussants of the article have had patients who have gone through normal pregnancies subsequent to metrosalpingography.

J. E. Habbe, M.D.

Contribution to the Roentgen Therapy of Lymphogranulomatosis, with Special Consideration of the Latest Clinical Investigations. Carl Kruchen. Strahlentherapie, 1929, XXXI, 623.

The author presents a critical discussion of all known facts regarding Hodgkin's disease. He asserts that any progress in the treatment of this disease must result from a better understanding of its etiology and not from the improvement of the therapeutic technic. Histories of 14 cases which he has observed are tabulated in condensed form. Early diagnosis is most important. X-ray therapy to all enlarged glands and the adjacent regions seems to be the best remedy. The suggestion of Desjardins to expose all gland-bearing regions of the body has not been adopted; on the contrary, the author advises not to expose any normal lymph tissue, particularly in the chest and abdomen. Spleen and bone marrow are sometimes irradiated with small doses, chiefly in the late stage of the disease. Control of temperature and blood is important as guide for the therapist. Doses from 30 to 80 per cent H.E.D. to the enlarged glands are recommended. A filtered radiation of from 140 K.V. to 180 K.V. should be employed. General treatment with the aim of building up the blood and resistance is essential. Between the X-ray treatments there should be intervals of sufficient length for the blood to recover from the effects of the irradiation.

E. A. Pohle, M.D., Ph.D.

A Simplified Method for X-ray Studies of the Accessory Nasal Sinuses. H. Coulter Todd. Laryngoscope, October, 1928, XXXVIII, 688.

The author describes a method of visualizing the accessory nasal sinuses which he claims is so simple that any rhino-radiologist may use it with great ease and considerable satisfaction. After thoroughly cleansing the nose with a mild alkaline douche he cocainizes the entire Schneiderian membrane with 1 per cent cocain hydrochlorid and 1 per cent ephedrin solution. Sufficient suction is then applied to empty the sinuses of any fluid or pus they may contain. With the patient in the dorsal position upon the X-ray table sufficient lipiodol is dropped into each nostril to cover all the nasal openings of the accessory nasal sinuses without much, if any, of the oil passing into the nasal pharynx. The angle of the occiput with the trunk should be a little less than 45 degrees, depending upon the location of the middle meatus as observed by the rhinologist. The patient is then instructed to seize the nose tightly between the thumb and index finger of the right hand and exhale deeply. Then with his mouth and lips closed tightly, the patient is asked to attempt to pull air into the emptied lungs through the tightly closed

nose, slowly but with all the strength possessed. While thus attempting to breathe through the closed nose have the individual suddenly relax his hold. This procedure must be repeated from five to fifteen times, while the rhinologist continues from time to time to drop more lipiodol into the nostrils. After filling the sinuses in this manner the nasal cavity should be thoroughly cleared of all excess oil by using sterile cotton upon nasal applicators. X-ray films may be taken at the Granger angles, but they must be taken postero-anteriorly.

This is such a simple procedure that the author feels sure it will be found helpful in all studies of the accessory nasal sinuses, either in the normal or pathologic states.

B. C. CUSHWAY, M.D.

Radium Therapy of Carcinoma of the Vulva. Iwan v. Büben. Strahlentherapie, 1929, XXXI, 713.

In the years 1918–1928, 31 cases of carcinoma of the vulva were observed in the women's clinic, University of Budapest. Following biopsy, 1,200 to 2,400 mgh. of radium were applied to the lesion. This may be repeated, if necessary, after from six to eight weeks. The adjacent glands receive roentgen-ray therapy three times at six-week intervals. The dose amounted to 400 R (measured in air) each time. All cases were carefully followed up. Two patients were free of recurrence six years after the treatment; one patient lived four years, two lived three years, three lived two years, five lived one year, after irradiation. Within the first year seven patients died. The remaining seven cases did not return for re-examination. Four cases are still under observation.

E. A. POHLE, M.D., PH.D.

Effects of Massive Doses of Irradiated Ergosterol: Preliminary Report. Irwin J. Klein. Jour. Am. Med. Assn., Feb. 23, 1929, XCII, 621. (Reprinted by permission from Brit. Med. Jour., June 1, 1929, p. 96 of Epitome of Current Medical Literature.)

The author, having produced rickets in albino rats with a low phosphorus ricketogenic diet, placed them in three groups. One group, which served as the control, was exposed to reflected daylight. The second group received, in addition, 2 per cent cod liver oil. The third group was given daily 20,000 to 100,000 times the dose of irradiated ergosterol in sesame oil necessary to cure rickets. The experiment lasted for one month, during which the ricketogenic diet was continued.

The author found these massive doses of ergosterol caused (1) anorexia and loss of weight; (2) the blood calcium concentration to be 50 per cent higher than in the other two groups, while the phosphorus remained approximately the same, and (3) the protein concentration of the serum to be less and the albumin-globulin ratio higher than in Group 2. The bones of all the animals in Group 3 were healed, but the results indicate that these greatly excessive doses did harm.

Radiological Findings and Their Significance in Focal Dental Sepsis. James F. Brailsford. Brit. Jour. Radiol., December, 1928, I, n. s., p. 471.

Two reasons why so many individuals fail to appreciate the dangers of focal dental sepsis are, first, that many patients with well marked dental sepsis are in apparent good health, and, second, they usually fail to recognize that the gravity of the illness of such a patient, whose resistance has been suddenly broken down, is due to the added virulence acquired by the virus of the septic focus growing in a sensitized individual.

It is the author's opinion that a "dead" tooth is always a source of potential danger. Even though sterile when the root fillings were made, the main canal branches and dentinal tubules constitute a reservoir for dead organic matter which is in close association with the blood stream and which offers

attraction for an organism circulating in the blood stream. Owing to variability in resistance of different individuals to a given infection it is impossible to estimate the age of the lesion from its radiographic appearance.

The chief conditions arising from dental sepsis most frequently seen by the radiologist are arthritis, fibrositis, and neuritis. Arthritic changes are not demonstrable for some weeks or months following the onset of symptoms.

The practice of root canal filling of teeth whose root tips communicate with the antrum frequently produces infection of the antrum. In some cases infection from the apex of a tooth will cause a fairly extensive osteomyelitis of the maxilla or mandible.

The writer is of the opinion that every tooth which is causing systemic disturbance shows definite changes on the roentgenogram.

J. E. HABBE, M.D.

Treatment of Rheumatic Carditis by Roentgen Irradiation of Heart. R. L. Levy and Ross Golden. Am. Heart Jour., December, 1928, IV, 127. (Reprinted by permission from Brit. Med. Jour., May 18, 1929, p. 85 of Epitome of Current Medical Literature.)

The authors have treated 30 patients suffering from varying grades of rheumatic carditis with X-ray irradiations to the heart. Usually four applications, each representing 10 per cent of an erythema dose, were given at fortnightly intervals; some patients received two or more such courses, a month's interval elapsing between each. The following alterations in the electrocardiogram were observed: inversion or deepening of the T-waves in 18 cases; inversion or flattening of the P-wave in 9 cases; change in the electrical axis in 7 cases; occasional alterations in the QRS complex, and extra-systoles and changes in the PR and RT intervals.

Of the 30 patients, 21 showed clinical improvement at the end of the follow-up period. In some patients the improvement appeared to be definitely related to X-ray therapy, and it was found that early cases in the first attack of rheumatic fever were most likely to derive benefit. The 5 cases terminating fatally were all instances of progressive active rheumatism with severe lesions and consequent failure. It was observed also that 5 out of 7 patients complaining of severe chest pain were relieved by X-ray treatment. Orthodiagraphy showed no changes in the size or shape of the heart after irradiation, nor were there any evidences of unfavorable effects upon the course of the disease, although such symptoms as nausea, headache, and chest pain arose in several instances. Four patients suffering from subacute bacterial endocarditis were treated by this method, but in no case was there any improvement.

The authors suggest that X-rays act by desensitizing the tissues of the heart which have become allergic to certain toxins produced by the rheumatic virus. They also suggest that in a first attack of rheumatism X-ray therapy may minimize the danger of cardiac involvement.
